Development in the depiction of depth

Thesis

DEVELOPMENT IN THE DEPICTION OF DEPTH

BY

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Abstract.

This thesis contains an investigation of the way in which children and adults depict depth when drawing a table.

Research on development in depiction is reviewed (Chapters 1 and 2), with particular reference to the use of pictorial depth cues and projection systems.

A series of studies on the use of projection systems in the drawing of a table is reported (Chapters 3 to 5) which shows that development in the depiction of depth is not directly related to development in the use of projection systems. It is also shown that the use of projection systems is task dependent, and is not closely related to the subject's formal understanding of them.

A formal system of classification of table drawings is introduced (Chapter 6), which demonstrates clear developmental trends in the way in which depth is depicted in the drawing of a table, and connects these trends with development in the use of pictorial depth cues.

The roots of development in the depiction of depth are examined more closely by further experimental work (Chapters 7 to 9). It is shown that subjects have a very strong preference for oblique projection, and that inaccuracy in the copying of line drawings is largely dependent upon the knowledge of what these drawings represent.

It is concluded that the results give support to an information processing view of development, in which the majority of subjects appear

to work from a form of canonical model of a table which has implicit depth and is best depicted by oblique projection (Chapter 10). It is also suggested that development in the depiction of depth is linked to the increasing use of pictorial depth cues. These conclusions are presented more explicitly in the form of a possible process model of the way in which we depict depth (Chapter 11).

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Lastly, I would like to thank Chas, without whose endless support, help and understanding this thesis would not have been possible. I must also acknowledge my debt to Graham and Michael, who were born in the midst of all this and accept it as a way of life.

Toddler, Playgroup, Nursery.

County Nursery, Leyland. Humpty Dumpty Playgroup, Leyland. Leyland Lane Methodist Playgroup, Leyland. Methodist Toddlers, Leyland. Old Civic Centre Mothers and Toddlers, Leyland. Prospect House Play Group, Leyland. St. Andrew's Toddler Group, Leyland. St. James' Toddler Group, Leyland. St. John's Playgroup, Leyland. The National Childbirth Trust. United Reform Playgroup, Leyland.

Infant, Junior, Primary.

Adlington County Primary. All Saints Primary, Chorley. Anderton County Primary. Bretherton Endowed, Croston. Broadfield County Primary, Leyland. Croston Methodist Primary. Earnshaw Bridge, Leyland. Farington County Primary, Leyland. Gillibrand County Primary, Chorley. Leverhouse County Primary, Leyland. Leyland Methodist Infants. Leyland Methodist Juniors. Longton County Infants. Longton County Junior. Mawdesley C.E. Primary. Moss Side County Primary, Leyland. St. Andrew's Primary (Woodlea), Leyland. St. Andrew's Primary (Fox Lane), Leyland. St. Anne's Primary, Leyland. St. Catherine's Primary, Leyland. St. James' Primary, Leyland. St. Mary's Infants, Leyland. St. Mary's Juniors, Leyland. St. Michael's Primary, Croston. St. Peter's Primary, Salesbury. Seven Stars County Infants, Leyland. Seven Stars County Junior, Leyland. Strathmore Primary, Hitchin. Woodlea County Junior, Leyland.

Secondary, Adult.

Balshaws High, Leyland. Bishop Rawstorne High, Croston. Bolton Institute of Higher Education. Chorley Adult Education Centre. Lancashire Polytechnic. Leyland Youth Centre. Open University Summer Schools. Prospect House Community Centre, Leyland. Runshaw Tertiary College, Chorley. Runshaw Tertiary College, Leyland. St. Mary's High, Leyland. St. Michael's High, Chorley. Wellfield High, Leyland. Worden High, Leyland.

Study 3 has been published in Lee, M. and Bremner, G. (1987) *The representation of depth in children's drawings of a table*, The Quarterly Journal of Experimental Psychology, 39A, 479-496.

Studies 9:1 to 9:5 have been published in Lee, M., (1989), *When is an object not an object? The effect of 'meaning' upon the copying of line drawings*. British Journal of Psychology, 80, 15-37.

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CHAPTER 1.

Overview of Theories about Development in Drawing.

Introduction.

Development in the depiction of depth, that is, in a person's ability to represent the three dimensions of space on a two dimensional surface, appears to be inextricably linked to general development in drawing. In order to study how the depiction of depth develops we first have to examine some of the difficulties associated with studying children's depictions and some of the theories that have been put forward to explain development in depiction. This chapter looks at general development in depiction and its relationship to the depiction of depth, whilst the following one focusses more closely on the latter.

There is a wide variety of theories that attempt to explain development in pictorial representation. These theories lack an underlying unifying structure, partly because they lack a common use of language and meaning, and partly because of the level of subjectivity in the research. For example, representation has been defined as *'the making present of an object intended to represent the real world'* (Furth 1969, Deregowski 1969). Yet, as observers, if we wish to put some structure upon the development of pictorial representation it is necessary to account for both our own interpretation of what we see (Wollheim 1969) and also the stated and inferred or implied intentions of the representer. For example, Kellogg (1970) examined a wide variety of young children's drawings. As can be seen in Figure 1:1 she found that drawings near the inner circle, done by very young children, are usually similar in form despite the fact that they are intended to represent widely differing objects.

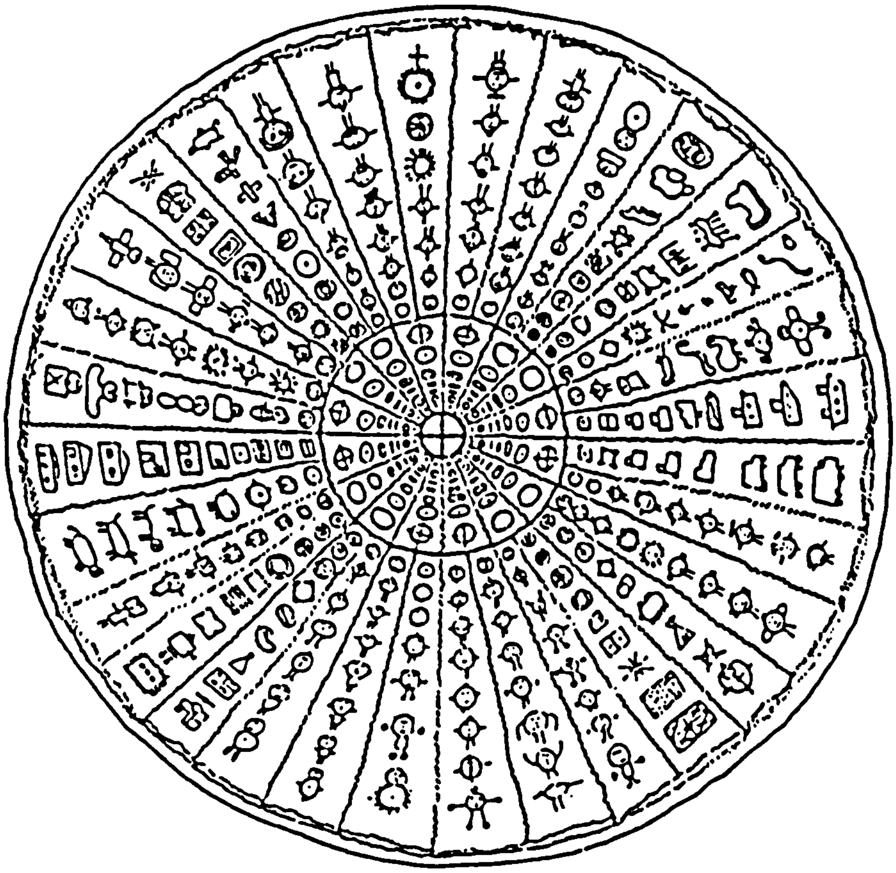


Figure 1:1. *Development in children's drawings from Kellogg (1970).*

The classification of children's drawings is also complicated by children's difficulty in articulating the intended representation, and the instability of their intentions. Adult's can generally explain what it is they intend to depict and can introspect as to reasons why they did not necessarily succeed, whereas a young child might begin to draw a house, but halfway through decide that a fire engine might be more appropriate and continue accordingly.

This form of investigation becomes even more subjective when development in the representation of depth is examined, as the investigator has to interpret the meaning of individual lines. Is that crooked line just a crooked line, possibly caused by an unfortunate wobble, or is it an early attempt at indicating three dimensionality?

The criteria by which people produced classification schemes of drawings also has a subjective element. Golomb (1974) found that the form of representation is a function of the specific task and medium employed. Yet, implicit in the construction of theories about how the representation of depth develops, there is the belief that these theories illuminate underlying developmental trends and thus describe behaviour that is not particularly task dependent. Historically there has been a desire to incorporate theories of drawing development within general theories of child development. In itself, the idea of a unified theory of development is obviously attractive. However, at times, the need for objectivity has been overlooked in order to incorporate empirical evidence of development in depiction into a general theory of development. These points are important ones, both for the structure of this thesis and the conclusions presented in it, and therefore it is worth exploring them more fully.

In this chapter theories relating to development in depiction are classified into four main groups according to the assumptions upon which they are based, and the implications which arise from them. This has been done in order to help to structure the discussion. It is possible to isolate three reasonably well defined groups of theories: theories involving stages in cognition, theories involving visual realism and production error theories. The fourth group, entitled conceptual/perceptual realism theories, covers a more loosely defined area with a shared information processing approach.

A) THEORIES INVOLVING STAGES IN COGNITION.

One group of theories has been dominated by a belief in the stage-like development of intellectual structures. Drawing is seen to be a reflection of this, and the end point of development is assumed to be the stage of formal operations, which, in depiction, is characterised by the use of linear perspective. Piaget (1977) states that:

> *"Intellectual structures between birth and the period of twelve to fifteen years grow slowly, but according to stages in development. The order of succession of these stages has been shown to be extremely regular and comparable to the stages of an embryogenesis. The speed of development, however, can vary from one individual to another and also from one social environment to another; consequently, we may find some children who advance quickly or others who are backward, but this does not change the order of succession of the stages through which they pass."*

Thus cognitive stages *"describe the actual psychological organisation of the child's knowledge and predict the child's knowledge about a range of objects and events"* (P. Miller, 1983). The importance of this for the present analysis is the assumption, highlighted in Inhelder (1965), that drawings give direct access to the child's 'imaginal space' which in turn gives direct access to the child's 'representational space' and to his or her understanding of depth. For example, Inhelder and Chipman (1976) comment that:

> *"Developmental psychology now seems to have shown that the image as the figurative aspect of cognitive functions takes on the status of a symbol by which it is possible to represent, to evoke, or to anticipate changes in reality ie. translations, rotations, and transformations of figures in space. Through our approach it has been*

shown that these figurative symbolisations develop along with, and closely depend on, the corresponding cognitive operations". The form taken by 'figurative symbolisations' is seen to be directly linked to the way in which the child draws, thus *"The identification of stages in the development of drawing ... attest to a remarkable convergence with the evolution of the spontaneous geometry of the child"* (Piaget and Inhelder 1969).

Stages of development in the understanding of space.

Because a close link has been postulated between the child's drawings and his or her understanding of space it is worth spending a little time examining how this understanding of space is seen to develop. Pufall and Shaw (1973) suggest that the very young child (sensori-motor, 0 to 2 years of age) has limited spatial ability, and that this is due to the lack of the symbolic function of intelligence, by which the child can imagine or mentally represent spatial relations among objects. The development of such 'representational space' is seen to coincide with the advent of the symbolic function, is developed through a long process of internalisation, and takes the form appropriate to the cognitive stage that the child is in.

At the pre-operational sub-level (2 to 7 years of age) representational space is seen as static, irreversible and egocentric. It is believed to be a topological space limited to the inherent properties of a particular object without locating the object relative to others in terms of a particular point of view or in a system of axes or co-ordinates (Piaget and Inhelder, 1956). Thus *"Retaining certain physical features of the figure leads the child to what one might call pseudoconservations and to a certain reluctance to exceed or cross the frontiers"* (Inhelder, 1965).

In the concrete operational sub-period (7 to 11 years of age) representational space is seen as mobile and reversible, whilst still dependent upon the presence of manipulable objects. Symbolic imagery develops, consisting of spatial figures and spatial relations which enable geometric operations to be performed (Inhelder 1965). The child is now believed to use projective space and Euclidean space, and so can use referents to understand constraints upon relationships between objects, and can use an abstract system of axial co-ordinates with precise distances and relative positions coded within it. Thus the child develops the ability to use an external frame of reference.

Finally, in the formal operational period (11 to 15 years of age) the child is believed to develop hypotheses about logical relations and form operations upon relations. Thus operations are independent from external criteria, though not from external reality (P. Miller 1983).

Stages in depiction.

Because drawings are seen as a direct reflection of the form of the child's representational space, and this is held to develop in stages, the concept of a stage like development in drawing is particularly important. Willats' (1977a) work exemplifies this view and is discussed in detail in Chapter 3. He examined the way in which children draw tables from a fixed view point. He found that with increasing age children are able to use increasingly complex forms of projection when drawing the table top, the oldest subjects using linear perspective. From this he argued that *"development appeared to take place in discrete stages. .... Each stage offers certain advantages over the preceding ones, but each stage is more complex than the previous one, and demands greater powers of abstraction."*, and that *"few children have the flexibility to change from one system (of projection) to another; having once learnt to draw in perspective most children would use this system for all their drawings"*.

He also argues that development (certainly in the earlier stages) occurs through a maturational process. *"If a child, through maturation, is ready to handle a more complex system, and is actively seeking it, the sight of a single example of the system in use (perhaps by another child) might be sufficient to trigger off the next stage of development.* Willats (1984) supports this view by pointing to the lack of cultural variation in the way in which young children use projection systems, and suggests that mechanisms of interaction between production and perception lead the child from one system to the next. Thus the idea of stages of cognition, very closely linked to stages in the use of projection systems, is central to this view.

The position of linear perspective.

Implicit within this is the assumption that the ability to use linear perspective is the end point of development. It is not suggested that all children develop the ability to use linear perspective. Piaget (1977) suggests that whilst drawing is a behaviour pattern that is originally subordinate to the general evolution in stages, it becomes diversified according to individual aptitudes. Thus all children progress through similar stages until approximately thirteen years of age, after which only some develop the ability to use perspective. Within this is the assumption that those who do not use perspective are less advanced than those who do. Similarly, it is assumed that if a child is capable of using perspective he or she will do so in all of their drawings.

Incidently, linear perspective is sometimes defended in the belief that it corresponds to our retinal image, however Finch (1977) has shown that our retinal image most closely matches hyperbolic perspective (similar to a 'goldfish bowl' view of the scene). Further, the retinal image is not a criterion for what we actually see. This idea, and the distinction between seeing and perceiving, will be addressed later in this chapter and will be returned to throughout the thesis.

Conclusions.

The general implication of theories involving stages in cognition is that the child's drawings give direct access to the child's cognitions. Willats (1977a) differs slightly from Piaget in this respect. He states that *"Less attention is given to the process by which the child is able to form an external representation of this imagined 'mental image' in the form of a drawing; and yet it is precisely the development of this process which allows drawing, as distinct from perception, to take place"*. Thus he attributes development in the drawing process to the way in which the 'mental image' is interpreted, as opposed to the way in which 'representational space' is understood. However, the assumption behind this is that we can 'read off' from our mental image, and so drawings are still seen as windows onto the child's cognitions, and the ability to use a particular projection system is still seen to indicate that the child understands that form of projection in its formal sense.

B) THEORIES INVOLVING VISUAL REALISM.

A second group of theories suggest that the endpoint of development in drawing is the ability to depict the world in a visually realistic way, as it is seen as opposed to how it is perceived. As with cognitive stage theories this is erroneously presumed to be linear, rather than hyperbolic, perspective. These theories suggest that the child moves from depicting what is known about the object to drawing the object as it is seen. Knowledge of the object can be thought of as taking two forms, knowledge of the object itself and knowledge of how to represent the object. Adults are believed to be less influenced by knowledge of the object because they have a greater repertoire of representational strategies. As with the first group of theories, development is seen to occur in cognitive stages, but they are linked to the understanding of representation rather than to the understanding of space.

Stages in the development of depiction.

The following stages are normally identified (after Luquet, 1927). The first is scribbling, in which no representation is apparent. The second is fortuitous realism, where some meaning is discovered in the act of scribbling and the scribbles are added to. The third is failed realism, in which there are representational intentions but because of synthetic incapacity the elements of drawing are juxtaposed or drawn all over the page. Fourthly comes intellectual realism, in which the child draws what he or she knows and not what is seen. In this stage the intuitive relations of proximity, separation, enclosure, and closedness are maintained with little or no perspective, and concealed objects are drawn as if visible. Crook (1983) suggests that *"the intellectual source of the naive drawer's work is segregated elements and relations ... the failure to* *cultivate shared boundaries and the striving for effective distribution in space reflects dominance by 'intellectual' enumeration of discrete elements within a scene ... the idea of a shared boundary is incompatible with (the child's) monolithic cognitive representations. In general, spatial transformations performed upon objects that do not conserve their individuality are not easily accommodated to the child's account of the scene".* The final stage is visual realism, in which the representation is an accurate copy of the object as seen, and an awareness of perspective and metric relations is shown.

Although this theory has been used to describe development in the drawing of a scene (Barnhart 1942) it is normally used to describe development in the drawing of a single object (Kaylan-Masih 1976). Mitchelmore (1980a) asked subjects to draw regular solids and identified a series of stages in the depiction of the solids that can be identified with the stages of intellectual realism. These are discussed further in the following chapter, but it is worth noting here that the depictions that he identifies as being in the final stage of development are in oblique projection. Oblique projection has an ambiguous status here, because whilst it is not visually realistic it is sometimes erroneously held to be the 'end point' of development in theories that suggest development is towards visual realism. Whilst linear perspective is not visually realistic in the absolute sense it is much closer to visual realism than is oblique projection. The following chapter analyses the difference between them more fully.

The use of an internal description.

The thrust of theories involving intellectual realism is a belief that an internal model is used, but that if the object to be depicted is unfamiliar, or if the child is encouraged to make a visual analysis of the object when drawing, then the child may not rely on an internal model and may be able to produce a more visually accurate depiction. These hypotheses were supported by work done by Phillips, Hobbs, and Pratt (1978). They obtained line drawings, either of a cube or a non object pattern, under two conditions. Either the child had to look at the model continuously or else was allowed to draw freely. Copies made in the first instance were found to be more accurate than those produced by free drawing. Further, line drawings of cubes were found to be copied less accurately than those of non familiar patterns. The two forms of stimuli were not of equivalent complexity, but a replication of the study by Willats (1981a) in which this was remedied produced comparable results. Phillips *et al* suggested that when the model is looked at continuously fewer intellectually realistic responses are produced because less memory is involved. For the same reasons a familiar model produces more intellectually realistic responses. They comment that *"When copying a drawing the internal description created by seeing the drawing as a solid object will presumably describe that object in three dimensional space (or at least in ways that go beyond two dimensional space)".*

Conclusions.

This interpretation goes beyond the idea of intellectual realism as a 'stage' in children's drawing, with concommitant assumptions about how the child's cognitive style differs from that of the adult. The misidentification of visual realism with oblique projection causes considerable difficulties, as what is assumed to be visual realism is simply another aspect of how the object is 'known' rather than 'seen'. This implies that intellectual realism is not just a 'stage' in children's drawing, but is an aspect in any representation, both for adults and children. For example, Edwards (1979) suggests that it is a general obstacle to drawing skill, whereby specific cognitive representations serve to guide, and thus distort, the representational act. The assumption that visual realism is the end point of development is the central difference between the theories in this group and those described in the final section. If this assumption is relaxed then the only difference between the two groups is one of emphasis. In the present group the emphasis is upon a form of development that is to a certain extent inevitable, though modified by experience. In the following groups of theories the child is seen more as an active problem solver.

C) PRODUCTION ERROR THEORIES.

Production difficulties can be defined as those unrelated to the organisation and representation of space, and include both poor motor skill and spatial and temporal problems posed by the drawing task and internal biases (Reeves 1983). Various aspects of spatial organisation such as the use of a base line (Clark *et al* 1967), reference to the sides of the page (Berman 1976), and more general organisational principles such as start and stop cues (Ninio and Liblich 1976), overcoming the aesthetic urge to radial symmetry (Kellogg 1979), developing symmetry within the scene (Golomb 1982) and the sequence of actual line placement (Bassett 1977, Ninio *et al* 1975) all form sets of decisions that could determine the final product.

Production error theories contain no assumptions about the end point of development and link development to the ability to overcome production difficulties. Those who have discussed the role of production errors do not necessarily suggest that all development in representation occurs because of the gradual overcoming of production difficulties, but they argue that at times this provides the simplest explanation. For example, Freeman (1980) suggests that *"production difficulties and performance biases are largely responsible for the curious ways in which children draw, and that conceptual explanations should be invoked only as a last resort"*. He argues that development through the different forms of projection systems found by Willats (1977a) in the drawing of table tops may well be explained by decisions that are local to the picture. For example, development might reflect the overcoming of an inability to produce linear inclination, irrespective of the symbolic content of the picture. A child unable to use obliques might draw a table in vertical oblique and progress to oblique projection when the appropriate skill is acquired. Similarly the progression to true perspective may follow the acquisition of the ability to draw the opposite oblique instead of two parallel lines.

Perpendicular bias.

Perpendicular bias lies at the heart of the explanation given above. Children have been found to be more skilled at reproducing lines perpendicular to a base line than they are at reproducing lines that form acute or obtuse angles to a base line (Olson 1970, Ibbotson and Bryant 1976), and it has been suggested that this is because they are biased towards drawing a line at right angles (Lark *et al* 1967, Eldred 1973). This bias might have a perceptual basis. Adults produce most error when estimating angles about oblique positions, and lines tend to be remembered as more vertical than they actually are (Fisher 1974, Byrne 1979). Four year olds have some difficulty in recognising obliques (Stein and Mandler 1975), although they can be taught to discriminate them (Strayer and Ames 1972). The drawing of oblique lines has been found to be more accurate when there are no conflicting frames of reference (Naeli and Harris 1976, Berman *et al* 1974), and Bayrakter (1985) found that the shorter the baseline the more effect the shape of the frame had upon the perpendicular bias. Berman (1976) suggests that oblique lines are seen as non-orthogonal to the picture frame rather than oblique as such. Hence when a local frame of reference is available the lack of ability to use an oblique line independently of it results in the production of a right angle.

Internal frame of reference.

It has been argued that a child becomes more able to use an internal frame of reference as she grows older, and hence more able to produce oblique lines (Bryant 1974, Freeman 1976, 1980a, 1980b). Knowledge of drawing rules may facilitate the ability both to anticipate and to keep reference points in mind (Rand 1973). Freeman and Hayton (1980) presented

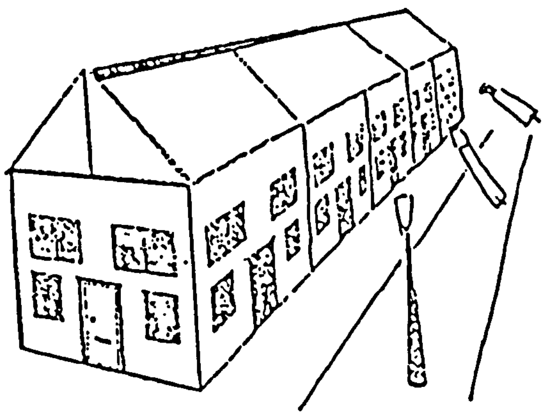


Figure 1:2. *The stimulus used by Freeman and Hayton (1980).*

children with a scene (Figure 1:2) and asked them to draw in the lampposts. They found that, until about eleven years of age, children represented the lampposts with a tilt and that these same children also drew tables in vertical oblique projection. They argued that this is evidence of the continuing use of an external frame of reference, with the implication that vertical oblique producers also used such a frame. Selfe (1983a) used a similar task, although the stimulus had greater symmetry around the vertical axis (it can be seen in Figure 2:2 in the next chapter), but did not obtain the same effect. It is possible that the differences found between the two experiments were due to the crosses with which Freeman and Hayton marked the bases of the lampposts, or the unsymmetrical nature of the stimulus. The different results do, however, cast an element of doubt upon the conclusion that the form of projection used is related to the frame of reference.

If development from vertical oblique to oblique projection results from local decisions or internal biases, then children who are unable to produce an oblique table top should also be unable to represent linear inclination, irrespective of the symbolic content. However, Willats (1981a) found that children were able to use a literal oblique line before they used one to represent depth. Hence, whilst overcoming internal biases might have some part to play in the development of representation, further explanation is needed for the development that Willats found in the use of projection systems.

Rule governed depiction.

Before invoking a conceptual explanation for Willats' findings it is worth considering the alternative possibility that development in the use of projection systems has rule governed origins. It has been shown that children follow certain rules when copying (Goodnow and Rochelle 1973). Systematic departures from these rules have been interpreted as attempts to minimise information overload (Gombrich 1960). Rule governed behaviour has also been shown to occur in drawing (Goodnow 1977) and drawing skill increases when children are taught how to reduce information load and are given feedback (Rand 1973, Sovik 1980, 1982). Some aspects of children's drawing that have been given conceptual explanations can, then, be interpreted in terms of rule governed behaviour. For example, standard orientation of an object can be seen as a form of rule-governed drawing. Similarly, Deregowski (1977) found that when children abandon vertical oblique projection in favour of oblique in the drawing of cubes they do so firstly in the upper portion of the cube. He argued that the child changed her drawing strategy for the bottom of the cube last because of her knowledge of the supportive function of the base, hence invoking a conceptual explanation. However, Willats (1981a) repeated this experiment, but also presented the child with a cube resting on perspex above his or her line of vision. He found that the top rather than the bottom of the cube was altered last, although the bottom still had a supportive function.

This appears to show an alternative, rule governed, explanation for Deregowski's findings, that the child draws the presenting face first, regardless of what the base of the cube is doing.

Drawing systems and drawing devices are used by Willats (1977b) and Freeman (1980b) to describe such rule governed behaviour. Thus, Freeman suggests that a drawing system is seen as "a set of rules for projecting a crucial aspect of the scene onto the picture plane". The implication is that these systems are disjoint. For example, Thomas and Tasalimi (1988) suggest that the overestimation of head size in young children's figure drawing is not due to the way in which the child conceives of the figure as such, but is related to the way in which the whole depiction is planned. Their use is seen to reduce information load and temporarily solve planning problems (Phillips *et al* 1978). Haith (1971) argued that children find it difficult to impose sequential ordering onto simultaneously presented material. Goodnow (1978) suggests that children use a set pattern or formula for drawing familiar objects. This formula is strong enough to be used erroneously, although the child can be shown to be sensitive to other aspects of the task (Parisier 1976, Ives 1980a). For example, Taylor and Bacharach (1982) found that five year olds could be encouraged to produce more visually accurate depictions by designing the task to minimise interference caused by drawing conventions. Development is seen to occur by transition between progressively more effective drawing systems by modifications of old programmes (Freeman 1972). Thus Freeman (1980b) suggests that movement from the use of one projection system to another might be attributable to movement from one drawing system to another, rather than development in the understanding of how to depict depth.

Drawing devices are discrete entities that deal with local points of difficulty within the picture, such as segregation, enclosure, interposition, and hidden line elimination. Fenson (1985) reported a longitudinal study of one child's drawings. He found that, initially, the child used discrete drawing devices when copying, and suggested that copying was, in part, dependent upon the child's ability to analyse the model in terms of the components present in his drawing repertoire. However it is here that the line between production difficulty theories and conceptual/perceptual realism theories becomes particularly thin. For example, Allik and Laak (1985) argue that whilst drawing devices are not laid down by the child's structural description, the relative size of the head and trunk in the human figure is. Both in this case and in Fenson's the child's production was partly related to his or her ability to analyse and hence to have a concept of the model.

Graphic motor schemata.

There appears to be no clear distinction between the idea of drawing systems and that of graphic motor schemata. However, whilst the use of drawing systems is normally discussed in terms of the way in which the child overcomes planning problems related to non-symbolic aspects of the depiction, graphic motor schemata are normally applied to more general aspects of cognition.

Karmiloff-Smith (1979) argues that once a functionally adequate system is developed it is considered as a unit in its own right, resulting in the development of a more efficient system. For example, the stability of the system does not appear to be in the motor sequence itself, but in the understanding of the completed graphic version. Thus for the repeated drawing of the same object strokes can be produced in different directions and different orders (Van Somers 1982). Similarly, children have been shown to change drawings of identical objects according to the context (Fujimoto 1981, Roodin *et al* 1971a, Roodin *et al* 1971b, Roodin *et al* 1973, Kellogg 1970, Lindstrom 1967). In the same way development in the use of graphic motor schemata can be related to cognitive development. Davies (1980) argues that it is not the capacity of the working memory that develops, but that with increasing age there is firstly a growth in the range of memorizing strategies available to the child, secondly an increase in the child's own awareness of such strategies, and thirdly an increasing knowledge of the strategies that are appropriate for different learning contexts. Similarly, Jools (1982) suggested that older children produce more features in their drawings because they are able to make greater use of pre-planned organisation, rather than because they notice more features than do younger children.

Arnheim (1974) suggests that other processes are affected by such development, and this is supported by the work of Taylor and Bacharach (1981). They found that whilst scribblers and mature drawers chose a complete man as the best form of representation of a man, children who produced tadpole men preferred tadpole men. Similarly Reeves (1983) argues that it is impossible to explain the difference between the perception and production of pictorial devices by production problems alone. Whilst it is quite probable that conceptual explanations for aspects of drawing behaviour are offered too readily, it is difficult to explain development in drawing, as opposed to aspects of production, without resorting to them.

Conclusions.

Theories which concentrate on production difficulties stress the need for clarity when we attempt to look at what is causing development. If development occurs irrespective of the symbolic content of the object or scene being drawn then it is reasonable to suggest that such development is related to the developing ability to overcome production difficulties. If development appears to be related to the symbolic content we have to look further, attempting to investigate what production difficulties there are, whilst also forming hypotheses about why content affects development in the way that it does.

D) CONCEPTUAL/PERCEPTUAL REALISM THEORIES.

These arguments lead us directly into the fourth major group of theories in which the emphasis is upon what we know of the object (its symbolic content) and what we wish to communicate about it, and in which depiction is seen as a problem solving task. These theories share a common information processing approach, and so both theoretical and experimental work in the area needs to be described briefly before common assumptions specific to depiction can be addressed. Three areas are of particular relevence to the discussion, namely the perception, conceptualisation, and mental representation of objects. An extensive review of these areas would be intrusive, therefore the essential structure of this work is sketched in Appendix 1 and only the main conclusions, as they relate to depiction, are given here. The initial discussion has been broken into these three parts for ease of accessibility, but in reality these parts are linked together very closely.

Perception.

Perception relates to the analysis we make of the sensory information we receive. The area is not limited to visual information, although it is only this aspect of perception that will be discussed here. Visual perception can be defined as the process of identifying an input, in the form of a retinal image, as signifying a three dimensional real world object. Perceptual theory, based on Marr's (1982) ideas, suggests that perception occurs by a series of grouping processes. A central part of Marr's theory, and of some computer vision systems, is that of the intrinsic image (2½D sketch), which is an intermediate representation that makes explicit various aspects of visible surfaces. Thus *"To recognise a visual object is to extract from the image a (hierarchically organised)* *description of the orientation of its principal and component axes, their adjunct relationships and relative lengths. Then with the principal axis as the basis of the object centred co-ordinate system, the description is matched to a canonical model that is held in memory" (Marr and Nishihara 1978).*

Recent research has relaxed the need for an a-priori knowledge of objects. In 1987 Fisher proposed S. M. S.. This is a suggestive modelling system for object recognition, in which integrated multiple alternative representations use symbolic primitives to suggestively characterise the object and its shape. Thus he suggests the use of an intermediate representation that falls between the 2½D sketch and the model based object hypothesis. These views are in accordance with Roth and Frisby's (1986) discussion of Marr's theory. They suggest that whilst Marr's theory is essentially one involving 'bottom up' processing, it also involves knowledge. However, this is not knowledge of objects or things, or of the world as such, but is 'procedurally embedded knowledge' in which perception is guided by general rules about the way in which the world is organised. For example, Fisher 1982 showed that a computer could identify tables, even if the edge data and boundary connections were missing, by decomposing the table top and table legs into separate symbolic elements.

Marr suggests that the representation system for a three dimensional shape needs to be:- a) Object Centred. A viewer centred system would be more accessible for description but, when used for recognition, would be non-canonical and more costly in storage. b) Volumetric. A volumetric system can explicitly carry information about the spatial disposition of the parts of an object that are only implicit in a surface based representation. c) Modular and Hierarchically Organised. If all the primitives were at the same level the lower order descriptions would capture too fine a detail, whereas hierarchical descriptions are intrinsically stable. These constraints hold strong implications for properties of the perceptual processes. In particular, the object centred nature of the system implies that our perception of an object has implicit depth, we construct it in terms of its symbolic elements, occlusion is a highly salient depth cue and oblique projection has more in common with the way in which we perceive objects than does perspective. Work on picture perception supports these findings.

Picture perception.

Jahoda *et al* (1977) suggest that the visual experience of objects in the real world is sufficient to lay the foundations of an ability for picture recognition, and Keneddy and Silver (1974) suggest that this is because lines are surrogates for features in the visual environment. For example, young children have little difficulty in recognising pictures of objects, and can do so with no indigenous art or explicit tutoring (Keneddy and Silver 1974, Keneddy and Ross 1975). Similarly the perception of pictures of isolated objects presents less of a problem than the perception of spatial relations within pictures (Hochberg and Brooks 1962, Hagen and Jones 1980).

It is perhaps unwise to accept that percepts can be directly linked to a form of projection, but there is evidence to suggest that whilst the retinal image records something similar to hyperbolic projection the majority of older subjects prefer objects to be presented in oblique projection. Hagen and Elliott (1976) presented adults and children with a computer generated range of stimuli, differing in the degree of convergence of the orthogonals, an example of which can be seen in Figure 1:3. They found that objects in oblique projection were much preferred to those in linear perspective, and further that the pictorial station point was seen as independent of the correct centre of projection for the picture. Hagen and Jones (1978) found that four year old children did not have a strong preference for oblique projection, choosing at chance level.

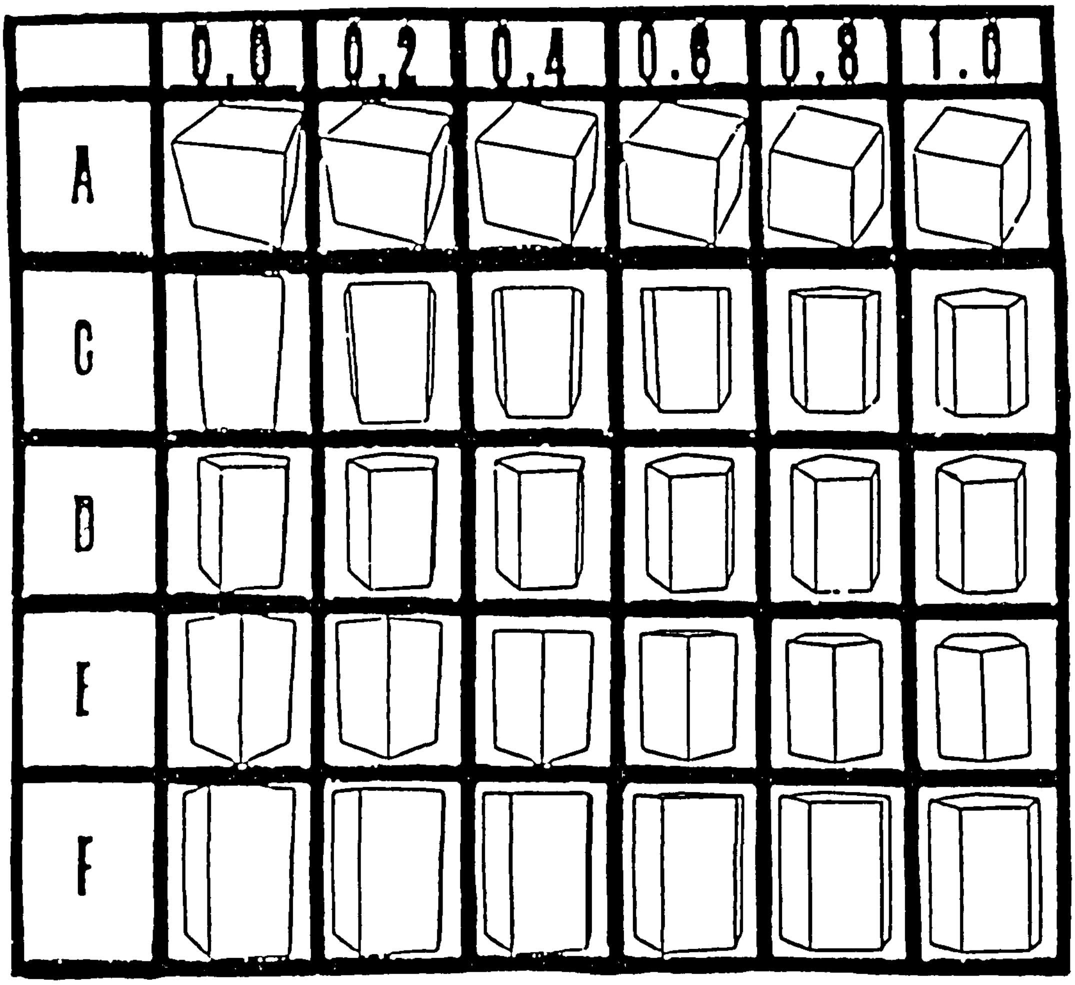


Figure 1:3. *An example of the stimuli used by Hagen and Elliot 1976.*

In order to make compensations for the pictorial station point it is necessary to make assumptions about the nature of the environment, as optical information alone cannot determine the correctness of viewing point (Rosinski 1976). Farber and Rosinski (1978) identify two such assumptions. Firstly objects are assumed to be symmetrical, rectangular, and regular. Secondly the correct viewing point is assumed to be along a line normal to the centre of the picture, so the observer compensates for dislocation of the actual viewing point from this ideal. Hagen 1976b suggests that young children appear unable to compensate for perspective distortion involved in a mismatch between pictorial station point and the correct centre of projection for the picture, and that the ability to do this develops gradually with age. This development supports the view that preference for an object in a particular form of projection does not give direct access to the cognitive representation of that object, unless we believe that that also changes with age. However, the very strong preference for oblique projection does suggest that it holds a special position in perception and Huffman (1971) suggests that this is because oblique projection offers a non-specific view point, and as such is a more effective method of representation.

Conceptualisation.

Conceptualisation can be defined as recognising that the three dimensional object belongs to a particular class. Rosch (1976) suggested that we use a system of natural categories when conceiving objects, and that these are internally structured into a prototype (best example) of the category with non-prototype members ordered from better to poorer examples. Prototypes have the advantage that they yield the most information for the least cognitive load. The form that these categories might take is unclear, but Rosch (1975) did suggest that *"pictures may be closer to the underlying representation than are words.... the high agreement on canonical orientation is itself of interest: one may speculate that the canonical imagined orientation represents the most informative perspective in which to view the object"*. The object centred nature of perception and conceptualisation and the ideas of prototype and canonical orientation suggest that oblique may be the form of projection that most closely approximates to a canonical representation of depth. It is the form of depiction preferred by most subjects, and appears to maintain the structural relationships between the symbolic elements of the object in the most informative way. Let us assume that a subject has a canonical representation of an object in depth, and that if it were to be depicted it would be best represented by oblique projection, following Minsky and Papert's (1972) suggestion that drawings can be seen as approximations to canonical representations. It cannot be assumed that the child is able to scan his or her canonical representation and therefore draw the object in oblique projection. Even children possessing eidetic imagery only produce drawings normal for their age when attempting to copy their image (Metz 1929). The earlier discussion on production error theories suggests that there might be many reasons for the child's inability to depict what he or she wants. The child, as a problem solver, tries to develop methods of overcoming these (Freeman 1980). The following discussion about mental representation addresses this aspect of depiction from an information processing approach.

Mental representation.

Both perception and conceptualisation can be seen as aspects of mental representation, so in order to avoid confusion quite a close definition will be applied here. Perception will be assumed to be the process of input, conceptualisation to be the process of storage and mental representation to be the process of preparation for output. Thus mental representation indicates the 'workbench' area of information processing. The term 'mental representation' rather than 'mental image' is used to reduce any unwarranted assumptions about its pictorial nature.

Slack (1984) suggests that mental representations have two components. The first is a surface representation, which corresponds to one's experience of the mental representation, and the second is that of knowledge structures. The surface representation is generated from knowledge structures and detail is built by activating literal encodings associated with each of the object's parts. This division can be likened to that between perception and conceptualisation.

Meaning is modality free, and the information retrieval systems themselves have no modality. The construction of the mental representation is related to the expected form of output, not the input (Chase and Clark 1972, Pylyshyn 1973).

Mental representation and perception have been shown to utilise the same procedures, share the same generating mechanisms and interfere with each other. Mental representations are manipulable in size, colour and perspective, and can be rotated, reflected, and sheered. They have standard orientations and change to more canonical projections over time. The term 'image space' is used for an entity within which the surface representation is manifest. The properties of the image space have been determined empirically. It is finite, having definite shape and size, and subtends a particular visual angle. It functions as a co-ordinate space and has metric properties. Images have limited resolution; not only are subjectively smaller images more difficult to see, but the resolution is clearest at the centre. Finally, images are known to be transient (Finke and Kosslyn 1980, Kosslyn 1975, 1976, 1978b).

Recent work by Farah (1988) suggests that there are close links between visual imagery and visual perception. She used electrophysiological and cerebral blood flow studies to show that brain activity during imagery was localised in the cortical visual areas. She also showed parallels between the selective effects of brain damage on visual perception and imagery, and she concluded that visual imagery does engage some of the same representations as used in visual perception. Thus visualisation can be seen as a form of short term visual memory.

From this it follows that mental representations can be seen as working models which are generated to solve problems and define new structures (Pylyshyn 1973). Tasks are arranged mentally as they would be physically and are constrained by the subject's understanding of the problem and the environment (Chase and Clark 1972, Pylyshyn 1973, Huttenlocher 1968, Simon and Barenfeld 1969, Cohen and Foley 1982).

Conceptual/perceptual realism theories and the depiction of depth.

Because conceptual/perceptual realism theories are based on an information processing approach they assume that developmental factors which influence information processing will also influence depiction. In order to limit the discussion the following section will concentrate on factors that are directly related to the depiction of depth, rather than general depiction. However, it is worth noting here that aspects of cognition such as attention and memory and problem solving abilities such as encoding knowledge, manipulating mental representations and ignoring non-salient aspects of the task will all differ with age and ability and will have an effect upon development in depiction. A more detailed discussion of these is given in Appendix 1.

Object centredness and depth cues.

The above discussion has emphasised that, regardless of how 'knowledge' of the object is stored or operated upon, it appears to have an object centred nature. The object centred nature of perception means that features of the environment are assumed by subjects to be more rectangular than they actually are (Lynch 1960, Chase 1983), and that separation of objects is given a high priority (Pratt 1982). It also has implications for the way in which depth cues are perceived. Shape constancy means that young children are inattentive to the particular orientation of an object (Braine 1978, McGurk 1972, Schaller and Harris 1974, Gibson *et al* 1962) and to the degree or direction of slant of oblique lines (Quinn and Bomba 1988). Contours are seen more readily than elements, and lines that are structurally relevant to the figure are seen more easily than those that are not (Vurpillot 1969, McClelland and Miller 1979, Waltz 1975). The importance of occlusion as a depth cue is therefore accentuated, as it is directly related to the relationship between objects (Hagen 1976a, Ratoosh 1949, Gibson 1950, Mascelli 1966). Thus young children can understand overlapping line drawings with ease, regardless of whether realistic or geometric, but have great difficulty in analysing figures with shared boundaries (Ghent 1956).

Size constancy means that young children are inattentive to the relative size of objects, perceiving all objects in a scene scaled in size relative to each other, irrespective of their relative distances (Gogel 1974, Wilcox and Teghtsoonian 1971). This has implications for the use of relative size as a depth cue. In perception the saliency of height in picture plane and relative size appear to develop with age (Olson 1975, McGurk and Jahoda 1974, Hagen 1976b). Height in the picture plane and relative size are, however, important elements of linear perspective, which has lead to linear perspective being called a depth cue in its own right (Bartly 1941, Fry 1952, Mascelli 1966, Plumb 1969). Arnheim (1974) argued that on artistic grounds it is the strongest depth cue, and Oh (1968) suggested that it is the most salient. Unfortunately his study was flawed in several areas. He confounded height in picture plane with linear perspective, and clarity of detail with atmospheric haze. The conditions for different depth cues were not of equal difficulty, and he required verbal responses, which have been shown to be unsatisfactory (Donaldson and Balfour 1968).

The issue of linear perspective as being a depth cue in itself is discussed further in Chapter 2, where it is argued that it is better viewed as a powerful combination of depth cues.

Task dependency and children as communicators.

Another aspect of these theories is that they allow for a great deal of variation between individual children and between the drawings of a single child. Children are sensitive to the wording of questions (Barrett *et al* 1983, Barrett and Bridson 1985, Barrett *et al* 1985), to their context (Davis 1983, Cox 1981, 1985), and to the type of stimulus used (Chen 1985). Their performance is also influenced by the way in which they interpret stimuli (Ingram 1985). A child's drawings could be seen as passive reflections of the way in which they interpret the task demands, although Light (1985) argues that drawings are more than this. He suggests that they *convey* rather than *contain* information. He argues that drawings are sometimes used as messages in that the child will use a drawing to communicate according to what she perceives the task demands to be, that children differ more in what they are trying to do than in what they can do (Light 1984), and that children adopt a deliberate strategy to show features that they hold to be of significance (Light and McEwen 1987). This implies that development in the depiction of depth does not occur in the child's understanding of space, or in the ability to produce a visually realistic depiction, as such, but in the ability to depict what the child wishes to communicate about her knowledge of the object. These points, and further work relating to them, will be returned to throughout this thesis, but are introduced here to indicate the active role adopted by the child in depiction.

These arguments highlight another point. Children may want to communicate many things about objects. When examining development in the depiction of depth we cannot assume that the child always intends to communicate the spatial relationships between objects. For example, in a study by Ingram (1985) very young children were asked to draw a scene which contained one block on top of another. If the top block had a face on it the children tended to draw the stimulus as more doll like than it was in reality. When the face was absent the children attempted to depict the spatial relationship between the blocks. Thus from the child's point of view the communicative message of the depiction might not be to address the spatial structure of the object or scene. She might have the ability to depict spatial relationships, but only do so in a cursory way, concentrating on other aspects of the task. Even so, given the object centred nature of our cognitive processes, whenever a child draws an object, either from observation or imagination, she needs to develop ways in which she can cope with the depiction of the spatial relations of the structural elements of the object.

Explanations for development in depiction.

Pratt (1982) emphasises the perceptual origins of development in depiction. He investigated the copying of random straight lines, and found that children looked at the model significantly less than adults did. Further, he found that whilst there was no difference between adults and children in the accuracy of copying two lines, there was significant difference between them when four lines were copied, and he attributed this to a lack of planning and cross referencing on the part of the children, and not to a difference in the basic measuring capacities between the two groups. He concluded generally that knowledge of the appearance of the object is used in an attempt to reduce the information load on the working memory. He suggested that this load could be reduced by providing an external memory store, such as marking the paper with dots to indicate the end of each line, which has been found to be effective in improving performance (Rand 1973). He also studied the way in which a cube and lines of a cube formed into an abstract were copied by art students, psychology students, and children. He found that art students looked at stimuli of both kinds more than did either of the other two groups. The art students copied the two kinds of stimuli with equal ability, having highly structured mental descriptions and better long term recall of the stimuli. Psychology students and children used equal amounts of looking, and were both worse at copying the cube abstract than the cube. Further, the children produced typically 'intellectually realistic' pictures. The small amount of looking used by the psychology students and children led Pratt to conclude that they were ignoring some information and drawing upon their stored knowledge of the object and how to depict it to make up this deficiency.

On the basis of these findings Pratt suggests that *"If looking strategies are dependent upon schematic descriptions they must be 'selective' in what they look at. This implies a very important place in copying performance for 'overlooking' and its consequences. We conclude that 'overlooked' parts are filled in from pre-structured schematic descriptions relating to object or feature types". (Pratt 1982).*

Pratt (1985) argues that the perceptual system functions in terms of higher order abstractions, and that potentially useful information is lost by the use of these abstractions. It seems more likely that perceptual information relevant to the drawing process is lost rather than information which is necessary for the person to function in the environment. In other words the 'person in the street' looses 'artistic' information rather than information that is needed to move about and avoid bumping into things. Skilled artists spend about half of their drawing time examining the scene, and use many different methods to limit visual information when making a two dimensional representation, precisely so as not to lose the information that is relevant to the drawing process. This is supported by Radkey and Enns (1987) who found that the use of Da Vinci's window significantly improved the amount of occlusion used by young children. It is said that people with blurred vision tend to be better artists than those who can see well. The different methods used by skilled artists have the effect of limiting the intrusion of object-centred percepts, which may be based on features which are not of primary importance in drawing.

Phillips *et al* (1985) suggest that children become more skilled at depiction by learning to build and store new descriptions, and not by developing general strategies for looking at objects. Thus the explanation they propose has a conceptual emphasis. Crook (1985) suggests that *"either the child comes actively to resist the intrusion of a mental model as drawing decisions are made or such models come to assimilate more view-specific information"*, and argues that the first position is more appropriate. This is supported by Bremner and Moore (1984) and Moore (1987) who both found that the drawings of an unfamiliar object produced after it had been inspected were less visually realistic than those produced without an inspection. Bremner and Moore found the same effect occurred when the object was named, and suggested that object naming may lead to drawing from a canonical model.

It was suggested earlier that visualisation is a form of visual short term memory. Essentially the perceptual explanation for development in depiction concentrates on the visual short term memory, and the conceptual explanation concentrates on visualisation. Visual short term memory does seem to be an important factor in depiction. Phillips *et al* (1985) argue that young children might produce more stereotyped depictions than adults because they have poorer visual short term memory. Alternatively it could be that they do not use it in the same way, as Pratt would argue. However, there is evidence to show that artistically able children are better at remembering non-verbalisable shapes than their I. Q. matched controls (O'Connor and Hermelin 1983). They suggest that visual short term memory for these shapes is unrelated to I. Q.. They also found (O'Connor and Hermelin 1986) that artistically able children are better than the mathematically able on this measure, and were also better at identifying and naming drawings of objects or animals on the basis of minimal necessary information. They speculate that the artistically able have greater ability to generate and store pictorial representations/visual images than do other subjects.

The child as an active participant.

Although there are differences between the above accounts, the emphasis in all of them is upon graphically oriented alterations to a mental description of the object. The child is seen as an active participant in development that occurs by 'learning' how to produce a 'better' picture. This could be done by examining other people's productions (Wilson and Wilson 1982) or by learning how to decrease the saliency of cues needed for object centred perception, as discussed earlier. It could also be a function of the drawing process itself. Drawing is a sequential act and those parts already drawn provide a visual input. For example, the young child typically draws a cube as a square. Initially this square is taken to represent the whole cube, and later is taken as a two dimensional pictorial image of a face of the cube (Moore 1986b). Horizontal or vertical lines are added to this face and are taken to represent the other faces in a similar manner to the first. If a straight line is added, by error, in a crooked manner, then the perceptual system will represent this as three dimensional (Willats 1981a). The child may or may not appreciate the source of three dimensionality in the drawing. But, either way, she has added to her repertoire of drawing skills, and will be able to use this new skill in the drawing of other objects. Such stereotyping of production processes means that the child can work from memory. It might not be 'memory' or knowledge of the object as such, but knowledge of how best to represent one particular aspect of the object. Thus it can be argued that modifications to the schemata occur (for both familiar and unfamiliar objects) as skill with the medium increases, and as the relative salience of different aspects of the object in relation to its depiction alters.

Conclusions.

Conceptual/perceptual realism theories suggest that the representation system for a three dimensional shape needs to be object centred, volumetric, modular and hierarchically organised. This implies that occlusion is a highly salient depth cue, and that the use of height in the picture plane and relative size with distance will increase as shape and size constancies become less salient. It also implies that oblique projection has more in common with the way in which we perceive objects than does perspective, that oblique projection might be the most informative way in which to view an object and that oblique might be the form of projection that most closely approximates to a canonical representation of depth. This is supported by the argument that linear perspective is a culturally imposed phenomenon rather than a naturally occurring depth cue as its use presupposes a station point.

Conceptual/perceptual theories suggest that what develops is not necessarily the subject's knowledge of the object or of depth, but the subject's knowledge of how to represent objects in depth. The drawer starts with an object centred approach and learns to overcome this interpretation in order to present a two dimensional view centred or view specific scene in which objects have little meaning. The need for view specificity is seen as a byproduct of the task rather than a force driving development in the depiction of depth. The more drawing skills the person has, including that of perceiving aspects of the object salient to the task, the less the person has to rely upon inappropriate knowledge. Such development is a function of general cognitive factors and experience.

E) BRIEF COMPARISON OF THEORIES.

The four approaches outlined above differ quite substantially in where they place the source of developmental change. This leads to differing assumptions about the importance of the child's understanding of space and the role of mental representation and production problems in the drawing process. It also bears upon whether development in drawing is believed to occur in stages or is driven by the development of a variety of factors that together produce 'stage-like' behaviour.

If we wish to establish which aspects of these theories most closely describe how development in the depiction of depth really does occur there are certain well defined areas which merit investigation. Theories invoking stages in cognition suggest that development occurs in stages linked to the understanding of depth, evidenced by development in the use of a series of projection systems in which linear perspective is the final stage. Theories invoking visual realism also suggest that development occurs in stages, but that these are linked to development away from the use of an object centred method of depiction. It is important for both these groups of theories that development is towards what is actually seen, in other words a view specific method of depiction. Production error theories suggest that development can appear to have a stage like quality because of development in the use of graphic motor schemata, but that this may be due to the child gradually overcoming a wide variety of production difficulties, unrelated to the symbolic content of the depiction. Theorists within this group do not believe that all development in depiction can be explained in this way, but suggest that development of the ability to overcome production difficulties should be accounted for before we adopt more conceptual explanations. Conceptual/perceptual realism theories suggest that development occurs in the knowledge of how to represent the salient aspects of a three dimensional stimulus (regardless of whether the third dimension is real or inferred) in a two dimensional depiction. The end point of development can be view centred rather than view specific depending upon the task constraints.

The purpose of this thesis is to investigate the extent to which these theories are applicable to development in the representation of depth. In order to do this it is first necessary to consider, in more detail, ways in which it is possible to represent depth and ways in which we do actually represent it.

CONTENTS OF CHAPTER 2.

Theoretical and Empirical Aspects of Development in the Depiction of Depth.

CHAPTER 2.

Theoretical and Empirical Aspects of Development in the Depiction of Depth.

Introduction.

When we look at a picture of a scene there are aspects of it that enable us to perceive depth in it. These are commonly called pictorial depth cues, and it can be argued that they are similar to the depth cues we use when perceiving depth in the real world. Pictorial depth cues are normally held to be those of occlusion, height in the picture plane, diminishing size with distance, and texture and pigmentation gradients. Linear perspective is sometimes incorrectly referred to as a depth cue. As with other forms of projection which are all methods for displaying three dimensional information, it is not a depth cue in itself, but contains a particularly powerful combination of depth cues. I will look first at the common types of projection systems and then examine the depth cues listed above.

A) PROJECTION SYSTEMS.

The projection system in which a scene is represented can be determined by examining the lines in the picture which represent edges of the scene normal to the picture plane. In the real world they can be seen as the lines indicating the edges of objects that go away from us in depth. These are normally called orthogonal lines, and are illustrated in Figure 2:1. When the orthogonals are depicted as points the drawing is said to be in orthographic projection. Oblique projection results from depicting the orthogonals as parallel lines. Three forms of oblique have been identified by Duberry and Willats (1983), namely horizontal oblique, vertical oblique, and oblique, the last two of which are shown below. If the orthogonals are depicted as converging to a point then the scene is said to be drawn in linear perspective.

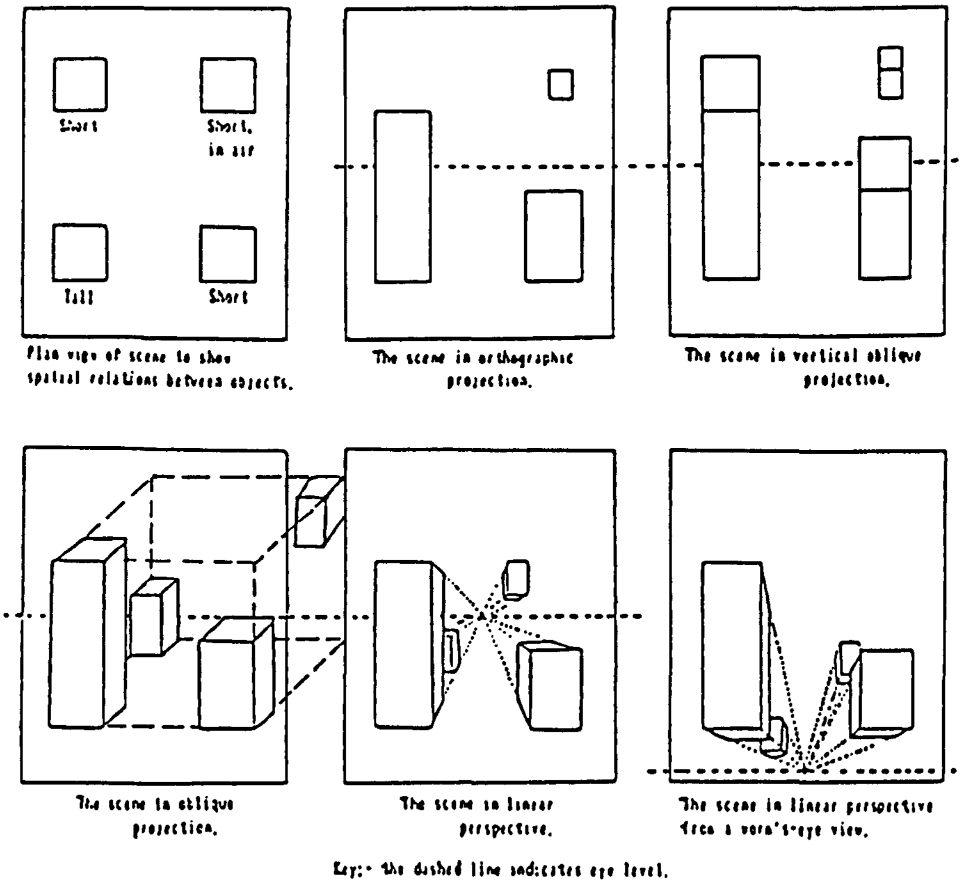


Figure 2:1. *Examples of different methods of projection.*

Linear perspective cannot be achieved without incorporating a single, specific, viewpoint into the picture. In linear perspective there is a different vanishing point for each family of parallel lines in the scene, and so the system of linear perspective is generally used for scenes in which there are several families of parallel lines of which none need to be orthogonal to the picture plane. If the scene does contain orthogonals they will converge upon a central vanishing point. The vanishing points are level with the observer's line of sight, and are thus often said to be on the horizon. Objects of equal size will always appear to diminish in size with increasing depth. In most depictions of scenes using linear perspective, objects also appear higher in the picture plane with increasing depth, but this is merely a function of the height of the line of sight. Objects in the distance and above the line of sight are drawn *lower* in the picture plane than those nearby. This is particularly apparent where a low line of sight is used. The production of linear perspective is governed by a few clear rules which can be used without understanding the theory behind them.

Figure 2:1 also illustrates the difference between a view centred scene and a view specific scene. In this thesis view specific is taken to mean the specification of a single view point, as would occur if one were actually seeing the scene. View centred is taken to mean that aspects of the scene are represented in a way that implies some concern about how the scene is actually viewed in real life, but it does not necessarily imply that a single viewpoint is specified in the depiction. In the illustration of oblique projection in Figure 2:1 each object is drawn as an individual unit rather than as part of the scene. Height in the picture plane, diminishing size with distance (between objects, not within them), and occlusion are all present but are used independantly of each other. In other words objects drawn in oblique projection can be integrated in a pictorial scene, and this scene can show a 'pseudo' view, but it is not an accurate depiction of the visual scene.

This does not mean to say that linear perspective is an accurate depiction of the visual scene. Hyperbolic perspective is a more accurate description of the retinal image (Finch 1977), yet it takes a great deal of conscious effort to see the scene in this way. Therefore, for the purpose of this thesis it is accepted that, of the commonly used forms of projection, linear perspective is held to be the one that most closely approximates the way in which we view a scene because of the way in which it specifies a unique viewpoint.

B) DEPTH CUES.

Occlusion.

Occlusion occurs when one object is seen in front of another, thus hiding the second object from view. Partial occlusion occurs when the boundary line of one object cuts across the boundary line of another. There is often a problem of interpretation in children's drawings which indicate the use of partial occlusion. We cannot assume that because a young child produces a line it is intended to represent a contour of the object. There is evidence to suggest that very young children use lines to indicate paths, then boundaries of whole objects, and only when they are older do they use lines as a contours (Spielman 1976, Fenson 1985, Moore 1986b, Reith 1988). These problems are lessened if we study the use of occlusion between objects, rather than within them.

Figure-ground separation is an important aspect of the visual scene, yet it causes young children great problems when it needs to be incorporated into depiction (Pratt 1985). Young children often draw separately objects that are occluded in the visual scene, and Crooke (1983) found them to be intolerant of both overlapping and shared boundaries. Hagen (1976a), and Freeman, Eiser and Sayers (1977) both suggested that occlusion is not normally found before the ages of eight or nine. Cox (1981) found a steady rise in the proportions of use of partial occlusion between the ages of six and ten years old. The development from showing objects as segregated to using occlusion may be linked to a development from object centred to view centred representation. In other words, young children may draw objects separately because of the object centred nature of their perception, conceptualisation and mental representation, and as they become aware of the need for view centred depictions, they start to use occlusion.

There is experimental evidence supporting the link between the use of occlusion and the perceived need for a view centred representation. When the salience of viewpoint is increased, more view centred behaviour results, both in drawing and copying (Light and Humphries 1981, Light and Simmons 1983, Light 1982). A specific example of this can be seen in the work by Light and MacIntosh (1980) who presented subjects with an object either contained in a glass or visible through one. In the first condition the glass was drawn as transparent, thus showing occlusion with no hidden line elimination. In the second condition the objects were drawn separately. Light and MacIntosh concluded that this was to emphasise that the object was not in the glass. There is also evidence to suggest that, in the right context (in this case that of drawing robbers hiding behind walls) children as young as four years of age will use occlusion if they believe there is a need for a view centred representation (Cox, 1981). Light and Foot (1986) extended these findings to show that a high level of partial occlusion can be elicited in six year old children by the use of dissimilar objects, or by the use of similar objects with an obvious 'front side'. They conclude that whether or not such children use occlusion might depend upon the way in which they interpret the experimenter's intentions.

To summarise, the use of occlusion may be linked to the perceived need for a view centred depiction. Its use appears to develop with age, but can be elicited from children as young as four years old under the right circumstances.

Height in the Picture Plane.

Adults generally draw objects which are near to them low in the picture plane and those which are further away higher in the picture plane. Hence height in the picture plane is to some extent taken to symbolise depth. When we look down upon objects, those further away are higher in our visual field. However, unless we have prior knowledge of the subject's eye level, we cannot make judgements about the view specific accuracy of the subject's depiction of a scene. Therefore, on its own, height in the picture plane carries few implications about the view specific nature of the depiction. All its use indicates is that the subject wishes to record the relative distances of the depicted objects from the viewer. If the definition is modified so that distance from the viewer is related to degree of closeness to a vanishing point (as in linear perspective), then 'height in the picture plane' does have implications for the specification of the viewpoint. This modified definition is not the one normally used and therefore will not be used here.

The use of height in picture plane does appear to develop with age. Very young children draw objects at different distances from them as separate items along the horizontal axis of the picture. Hargreaves *et al* (1981) suggest that the air-gap phenomenon, found in young children's drawings of scenes, persists in older children's drawings as a desire for a ground line. Freeman, Eiser and Sayers found that by about seven years of age the majority of children represented two objects, presented one in front of the other at eye level, as vertically separate. Bremner (1985a) found that children as young as six years of age will use verticality to indicate depth when the horizontal axis is already used to show a left/right relationship. Therefore, as with occlusion, the age at which a child will use height in picture plane appears to depend partly upon the perceived need for it within the context of the particular task in hand.

Unlike occlusion, the interpretation of height in the picture plane is unclear. It is possible that some subjects do not use height in the picture plane as a depth cue as such, but use it to depict a plan view. In other words, they choose to change their viewpoint to one in which they look down on the scene. Thus for some children development in the use of this depth cue might actually indicate development in the chosen viewpoint.

Diminishing size with distance.

Objects that are further away project a smaller retinal image than those that are nearer, but because of the object centred nature of our perception we perceive objects to have a constant size. Size constancy is therefore seen to be one attribute of object centred depiction. The ability to overcome size constancy and to use diminishing size with distance when depicting a scene is part of view centred depiction, and is a *necessary* part of view specification. As with height in the picture plane, its use is extremely hard to isolate from the use of other depth cues. Jahoda and McGurk (1974a) found that young children could make size judgements with considerable accuracy, and this finding was stable across cultures (Jahoda and McGurk 1974b,c,d). However, Olson (1985) found that whilst the understanding of changes in the retinal size of objects, as a pictorial depth cue, was apparent in some five year old children, this was not the case for three year old children. This implies that the young child's ability to interpret size of the object as a pictorial depth cue develops with age.

The ability to use diminishing size with distance as a depth cue also develops with age. Silk and Thomas (1988) found that young children do attempt to produce visually correct size scaling, but only on a size dimension that was salient and relevant to topic differentiation.

Therefore young children do not appear to use it as a depth cue in a rigorous way. Selfe (1983a) asked children to complete a picture in linear perspective by drawing in a lamppost half way along the street. The stimulus she used can be seen in Figure 2:2. She found that it was not until children were about seven years of age that they could complete it with any accuracy. It is not, unfortunately, possible to separate out the effects of height in the picture plane and diminishing size with distance in this study as the two covaried. It is very difficult to examine the use of these two depth cues independently, and the majority of work in this area has used them together when examining the child's increasing use of view centred depictions.

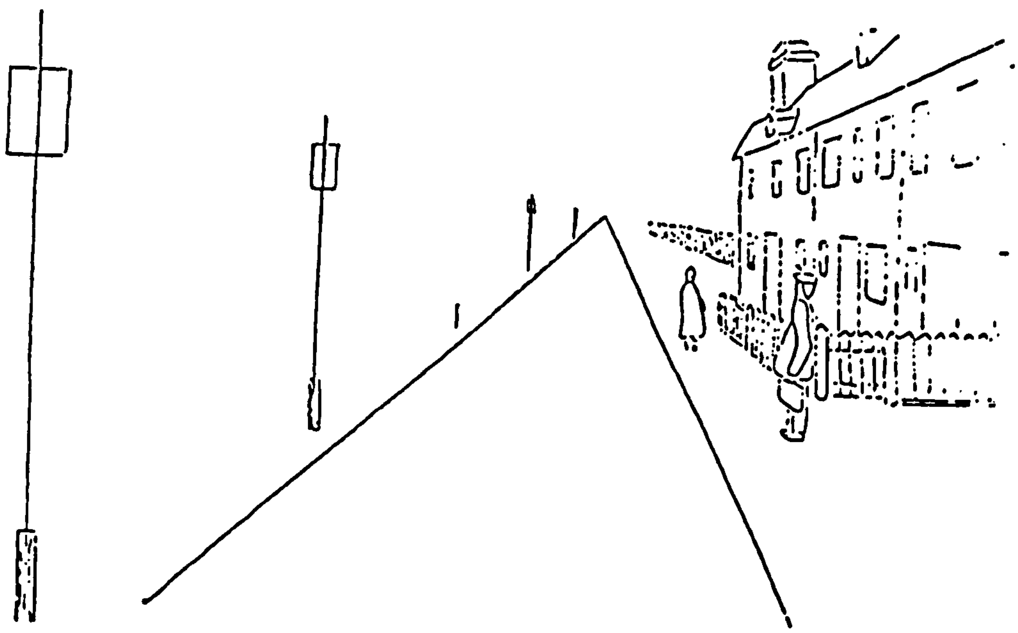


Figure 2:2. *The stimulus used by Selfe (1983a).*

Texture Gradient and Pigmentation Gradient.

Both texture and pigmentation gradients are cues by which the appearance of depth can be enhanced, and can be seen as secondary depth cues. Texture gradient occurs because the texture of the objects that are near to us is more visible than that of objects that are further away. Pigmentation gradient works in the same way. We see the colours of objects that are near to us as clearer and brighter than those of distant objects. Similarly we see objects that are near to us delineated with strong contrasts in colour and tone, whilst those in the distance show little contrast in their tonal values and appear to merge more with the background.

There is little experimental evidence on the perception and use of these depth cues. Rock, Schallo and Schwartz (1978) found that texture gradient was neither necessary nor sufficient for the perception of depth in pictures, suggesting that whilst the cue might enhance the perception of depth within the picture once the scene had been understood, the most important aspect of such perception was the interpretation of the scene. Nicholson and Seddon (1977) found that schoolboys' understanding of spatial relations in pictures was marginally increased by the inclusion of secondary depth cues, and Sinha and Misra (1975) found that some older children used these depth cues when painting.

From this we can conclude that secondary depth cues might enhance the perception of pictorial depth, but that they are rarely used, spontaneously, by younger children.

C) DEVELOPMENT OF THE DEPICTION OF DEPTH WITHIN A SINGLE OBJECT

One problem that keeps recurring is that of how we can interpret the child's intentions when all that we have to go on is the child's depiction. This concern is marginally reduced if we look at the way in which single objects are depicted rather than trying to interpret whole pictorial scenes where we have to make numerous inferences about the relationships between objects in these scenes. This tightens up the area of investigation whilst not critically reducing the amount of information that we can gain. We can still study the use of projection systems and depth cues in the depiction of a single object, provided the object is chosen appropriately. We cannot, however, necessarily assume that findings about development in the depiction of depth found within a single object will also apply to whole scenes. This problem is discussed later. The choice of an appropriate object is important. If we were to study children's drawings of highly emotive objects, such as 'mothers', we would once again widen the problems of interpretation. Similarly, it is important to look at objects that are not commonly drawn to avoid the possibility that stereotyping might dampen out important effects. A commonly used solution to these problems is to examine children's drawings of regular solids or other well known objects that do not occur frequently in spontaneous depiction, and are relatively free from emotional overtones.

The depiction of regular solids.

Mitchelmore (1978, 1980a) classified development in the drawing of four regular solids (a cube, a cuboid, a cylinder, and a pyramid), as can be seen in Figure 2:3. He found the same developmental sequences for each solid when replicating the study cross-culturally (Mitchelmore 1980b). The cube and the cuboid are the 'purest' regular solids, in the sense that each edge is parallel to one of the three rectangular co-ordinate axes. Mitchelmore found that these two solids provided the soundest measure of the base rate of development, showing both the clearest pattern of development and similar rates of development. By comparison he found that in the drawing of the cylinder the children went through the stages at an earlier age than for the other solids. This also occurred for the first stages of drawing the pyramid, but development in the use of the later stages of depiction of this object lagged behind their use for the other objects. The development in the drawing of cubes found by Mitchelmore has also been found by Deregowski (1977) and Willats (1981a,b, 1983).

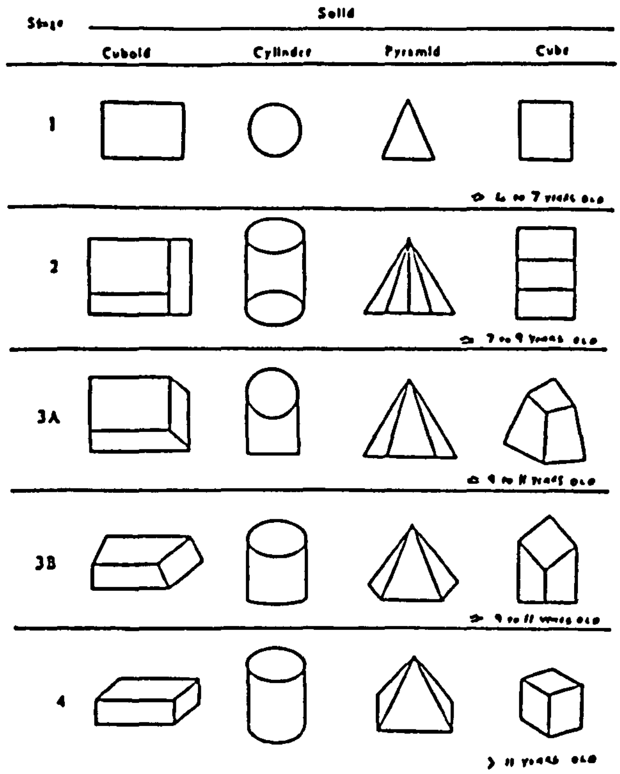


Figure 2:3. *Development in the depiction of regular solids (Mitchelmore 1980b).*

Denotation Systems.

This analysis of development already contains subjective elements. The drawings obtained from the children must have been grouped into stages, and the method of sorting that has been used is normally related to the sorter's idea of what is developing. For example, as explained in the first chapter, Mitchelmore used his findings as support for his ideas about intellectual realism. The lack of an independent, formal system of classification means that assumptions made in the sorting might have prejudiced the conclusions to a greater extent than would have occurred with such a system. Work done by Willats (1981b, 1983) illustrates this. He asked subjects to draw the object placed in front of them, which was either a cube or a cube with a smaller cube removed from one corner. He then attempted to classify the drawings by assigning dimensions to both the picture and the scene primitives.

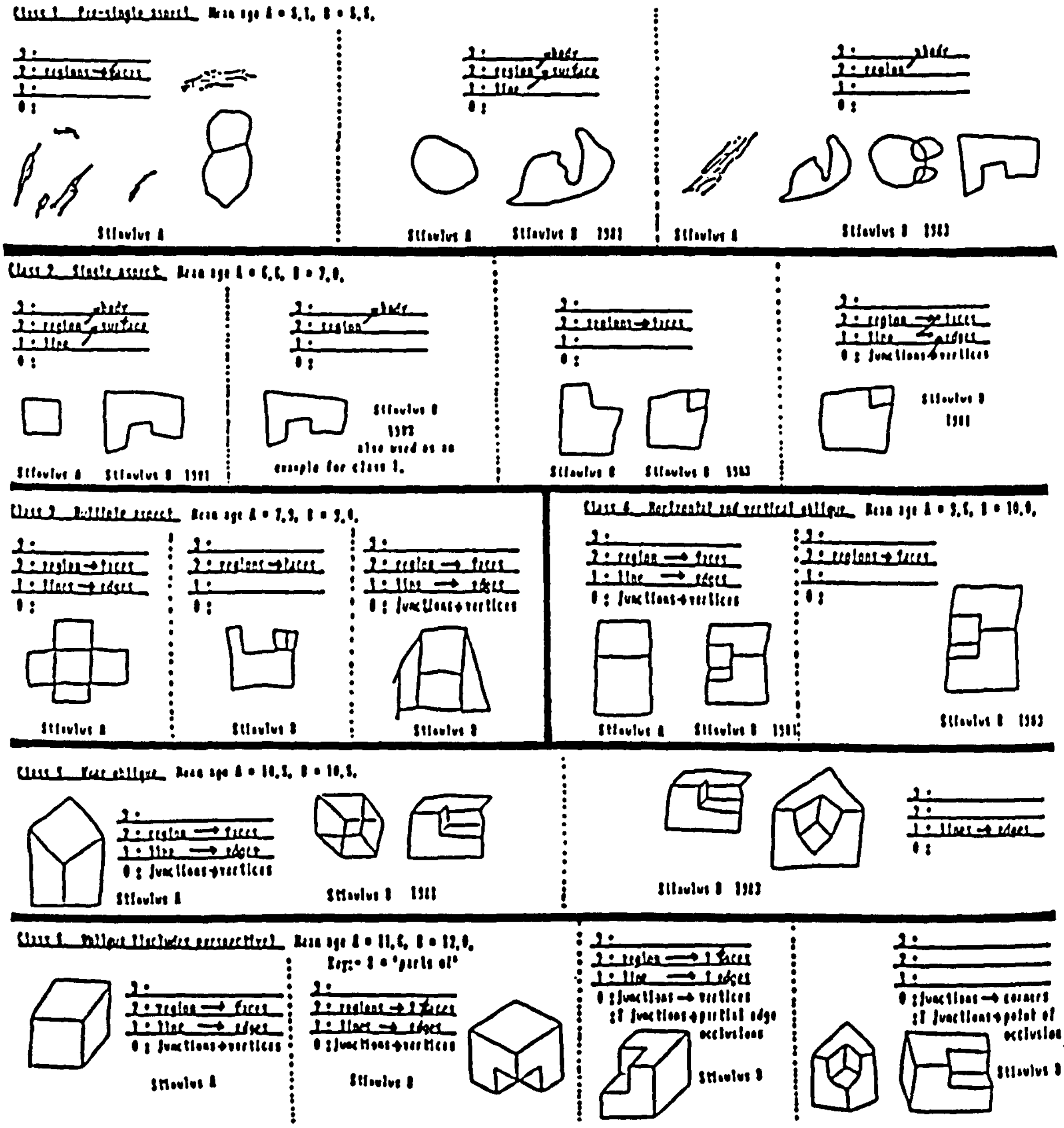


Figure 2:4. Classes of denotation proposed by Willats (1981b, 1983).

The lines in the picture and edges in the scene are both classed as one dimensional, regions in the picture and surfaces in the scene are classed as two dimensional, whilst bodies in the scene are classed as three dimensional with no pictorial equivalent. The problem comes in the interpretation of what the lines in the picture stand for. Figure 2:4 shows that Willats' own interpretation varied from one presentation of the idea to the next. The high degree of variability makes this a difficult system to implement and evaluate. Ignoring for the moment the subjective nature of the classification, its implementation becomes extremely complex when applied to the depiction of people rather than regular solids (Willats 1985). The difficulty in evaluating the system derives from the way in which Willats has linked it to development in the understanding and use of projection systems, without clearly showing how or why. If we assume that the lines in the picture do denote the aspects of the scene claimed by Willats, all we can reliably say about the development shown is that, with age, children appear no longer to use cross dimensional denotation. On this analysis we are not justified in reaching more general conclusions about the nature of a relationship between denotation systems and the understanding or the use of projection systems.

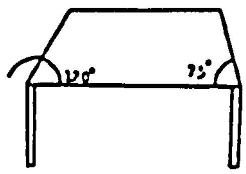
Projection Systems.

Willats' work in denotation systems highlights the need for a formal system of classification. He proposed (Willats 1977a) that projection systems could be used in this way. In this study he asked subjects to draw a table and analysed the projection system by which they depicted the table top. Figure 2:5 illustrates the method of classification he used. The projection system being used by the subject is determined by examining the lines in the picture, the orthogonals, that represent the edges of the solid normal to the picture plane. If the orthogonals are depicted as points the drawing is said to be in orthographic projection. The use of parallel lines, normally oblique on the page, indicates oblique projection. If the orthogonals are depicted as vertical lines, whilst still parallel, the projection is seen as a special form of oblique and is called vertical-oblique. If the orthogonals appear to converge to a point the solid is said to be drawn in perspective. Willats (1977a) divided perspective into two categories, naive and true, depending upon the amount of convergence shown by the orthogonals.

A) Method by which the angles of convergence (C) and obliquity (O) are measured.

Angle of convergence = 120° - 75° = 45°.

Angle of obliquity = $\frac{120° + 75°}{2}$ = 97.5°



B) Classification into projection systems according to measured angles.

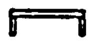
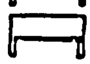
CLASS	PROJECTION SYSTEM	ANGLES	EXAMPLE OF DEPICTION	MEAN AGE
2	Orthographic	0° (C), 0° (O)		9.7
3	Vertical Oblique	< 20° (C), 70° to 110° (O)		11.9
4	Oblique	< 20° (C), > 110° (O)		13.6
5	Naive Perspective	20° to 60° (C)		14.3
6	Perspective	60° to 100° (C)		13.7

Figure 2:5. *Classification of the depiction of a table top proposed by Willats (1977a)*

Interpretation.

The assumption that the projection system in use can be derived from the table top alone is discussed in the following chapter. However, Willats' (1977a) work also highlights a problem that was touched upon in the first chapter. This is related to how we interpret the findings obtained from applying a classification system. The beauty of an account of the representation of depth directly related to the use of projection systems comes partly from the formality of the system. By ascertaining the form of projection that is used by the child the experimenter can identify the 'stage' of depth depiction the child has achieved. However, the fact that we have been able to classify the drawings within a particular system does not necessarily mean that our system is an accurate reflection of the way in which development occurs. Willats found that the way a table top is depicted appears to develop from the use of orthographic projection, through vertical-oblique, to oblique, and finally to the use of naive or true perspective. He used his findings to reach the conclusion that development occurs in a stage like way directly linked to the increasing understanding of more complex projection systems, and that linear perspective is the end point of development. The theory assumes that when children draw they attempt to depict exactly what they see, and that as perspective is normally considered the best method of achieving this, children are working towards drawing in perspective. Willats described what children do, but this does not give access to what they intend to draw, nor to rules governing the transition between systems. For example, Freeman (1980b) puts a different interpretation on the data. He suggests that what underlies transitions might be nothing more than the development of ability to produce firstly a pair of right angles, secondly a pair of oblique angles, and finally one oblique and one obtuse angle. In his view it is the use of these 'local decisions' that determine the way in which the table is drawn, not the degree of understanding of how to represent an object in depth.

Other studies cast doubt upon the generalisation that linear perspective is the end point of development. Jahoda (1981a) classified drawings of tables done by Ghanian students in terms of the projection systems used. He found that they rarely used any projection system more complicated than vertical oblique. Although the students he used were older than Willats' subjects they had little experience of depiction. The same point is emphasised by pictures of tables drawn by blind adults that

Kennedy (1980) collected. Typically the tables were drawn in the orthographic or vertical oblique form. Blind adults described other projection systems as unnatural because the form of the picture was then constrained by the point of view. Kennedy found that when a subject produced several table drawings in sequence they appeared to proceed along the 'developmental' lines suggested by Willats, as can be seen in Figure 2:6. He also found that when the blind adults were given table tops drawn in oblique projection or perspective to complete they usually drew in the legs by following the line of the table top, as can be seen in Figure 2:7.

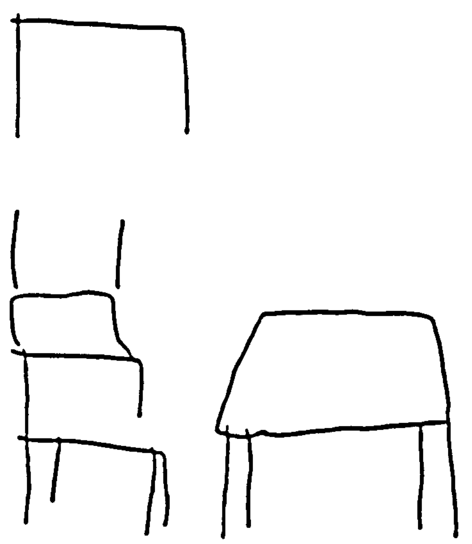


Figure 2:6. *The sequence of drawings obtained by Kennedy (1980) from a blind adult.*

Kennedy (1980) found that blind six to ten year olds were capable of understanding point of view, convergence, occlusion and shape transformation. He argues that haptic skill involves an intuitive sense of perspective (Kennedy 1983). S. Millar (1975, 1977) suggested that lack of feedback in the blind shows mainly in the articulation of the drawing, and Deregowski (1978) found that without experience functionally realistic rather than visually realistic representations are produced. This would suggest that the view specific (or even view centred in the case of blind adults) depiction of objects may be dependent upon the perceived need for such a form of depiction. If this is the case then it may be that development occurs in the perceived need for view specific depiction and not in the ability to produce it. This indicates the importance of clarity in the distinction between the developmental sequences we might find in the depictions in front of us and the assumptions we make about what is actually developing.

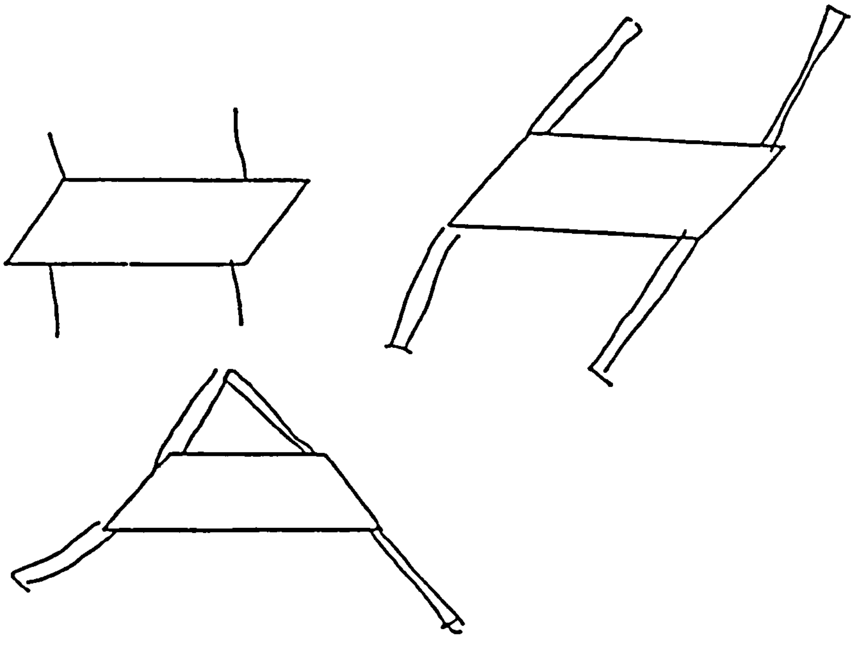


Figure 2:7. *Responses made by blind adults to the completion of a table top (Kennedy 1980).*

Applicability.

Ideally a formal system of classification should be able to account for the vast majority of examples of whatever is being classified. Unfortunately, as Willats (1985) discusses at length, one major problem with his 1977 account is that it does not apply to all forms of drawing. For example, Mitchelmore describes a stage in children's drawings (Stage 3, prerealistic) in which objects are drawn as if from one viewpoint. Within this stage there is a progression from the use of one base line, through the use of several, to the use of a base plane. Depth is depicted by overlapping and size differences. Drawings in this stage do not fit comfortably into any of Willats' classifications. Similarly, Hagen (1985) identifies some forms of projection, such as divergent perspective in which the orthogonals are represented as diverging rather than converging, which are used by children but which have no basis in reality. These points call into question whether analysis purely in terms of the projection system used uncovers all that is taking place in development and suggest the need for a more detailed form of classification.

Why Tables?

The experiments reported in this thesis investigate the way in which a table is depicted under a variety of different conditions. A table has been chosen for several reasons. A single object is used in order to clarify interpretation of the findings, as discussed above. Tables come high on the list of natural exemplars identified by Rosch (1975, 1976) and Rosch *et al* (1976), and hence it is reasonable to expect that most subjects have a clear idea of 'tableness'. Tables are not, however, normally highly emotive. They are also not often drawn on their own. This minimises the possibility of subjects responding with rigid, highly schematic drawing routines which they have previously developed for drawing them. Tables are essentially cuboid in appearance, and view centred depictions emphasise their cuboidal nature. Tables are, however, richer in appropriate detail than simple cuboids. Computer vision work on table identification (Fisher 1982) indicates that tables are most easily identified by assuming that the table top and the table legs are separate symbolic elements. Rules are then applied to these elements to determine whether their positioning matches that of a table. Thus tables were identified without the use of edge data and boundary connections. It should not be assumed that computational algorithms for the solution of a problem necessarily reflect the methods used in the brain, but Fisher's work does emphasise that the table legs can be seen as symbolic elements separate from the top. Because of this the use of occlusion, height in the picture plane, and diminishing size with distance can all be identified within the depiction of a table more readily than they can within the depiction of a cube, where the symbolic nature of each face is directly related to that of the other faces. Deregowski and Strang (1987) presented children with decompositions of a cube in order to address this question empirically and conclude that the difficulty which young children experience may lie in the conflict between the desire to convey the overall appearance of an object and the attempt to depict correctly its elementary parts. The final reason for choosing a table is the pioneering work already done by Willats (1977a) in attempting to provide a formal means of classifying the depiction of table tops, and concern about the conclusions that he reached.

In the following chapters Willats' work on tables is examined more closely. A more extensive system of classification is proposed, and, using this, the threads of what is developing in the depiction of depth are examined.

CONTENTS OF CHAPTER 3.

A Table Drawn from Observation.

Chapter 3.

A Table Drawn from Observation.

The work reported here has been published in the Quarterly Journal of Experimental Psychology, August 1987, and is given in Appendix 3.A.

Summary.

As noted in Chapter 2, Willats (1977a) analysed developments in the drawing of a table in terms of the projection system in which the table top was represented, and concluded that representation of depth in drawing goes through a series of discrete stages, each of which can be identified with a projection system. This chapter contains a partial replication of Willats' study using a much larger sample. The relationship between age and use of projection system found by Willats is supported, in general terms. Not all of the 'stages' are found to be discrete, however, and an examination of the way in which the table legs were drawn shows that whilst the majority of older children appeared to use perspective they did not use it correctly. A method is given by which tables that are drawn as if from a central viewpoint can be formally classified. It is concluded that development in the understanding of the representation of depth is not very closely linked to development in the use of projection systems.

Introduction.

The way in which objects are drawn, and depth represented, differs with the subject's age, and appears to develop with age in a specified manner. Willats (1977a) examined this apparent development by looking at the way children used projection systems when they were drawing tables. A large part of this chapter is devoted to following up points made and questions raised in Willats' work. The way in which he classified the table drawings is illustrated in the previous chapter, and will now be analysed more closely.

The assumption that the projection system in use can be derived from a table top alone can be questioned. The formality of this type of classification comes from the supposition that the projection system can be identified by the application of two formulae upon the angles contained in the depiction of the table top. These formulae isolate the degrees of convergence and obliquity shown by the orthogonals in the drawing. However, as can be seen in Figure 3:1, convergence of orthogonals is directly related to the height of the subject's eye-level.

A subject looking edge-on at a table top will see it in orthographic projection. As the eye-level rises the table top will appear in true perspective, and then naive perspective, and finally as if in vertical-oblique projection. Hence the degree of convergence does not uniquely define the projection system in use. In order to minimise ambiguity it is necessary to examine the way in which the whole table is projected. Therefore when analysis of the drawing is confined to the way in which the table top is depicted the psychological relevance of the way in which the projection systems are classed becomes less clear. Orthographic or vertical-oblique projection, as inferred by the form of the table top, might in reality represent a table drawn in linear perspective from an extreme viewpoint. Similarly, a distinction between naive and true perspective is not inherent in any formal method of classification. It is necessary to know something about the position of the child's eyes before one can with any validity make a distinction based only on the drawing of the table top. In fact this can only be made if the drawing has been done from observation and with a fixed viewing angle, as was the case in Willats' study, and always with the assumption that the child intends to draw exactly what he or she can see from that angle.

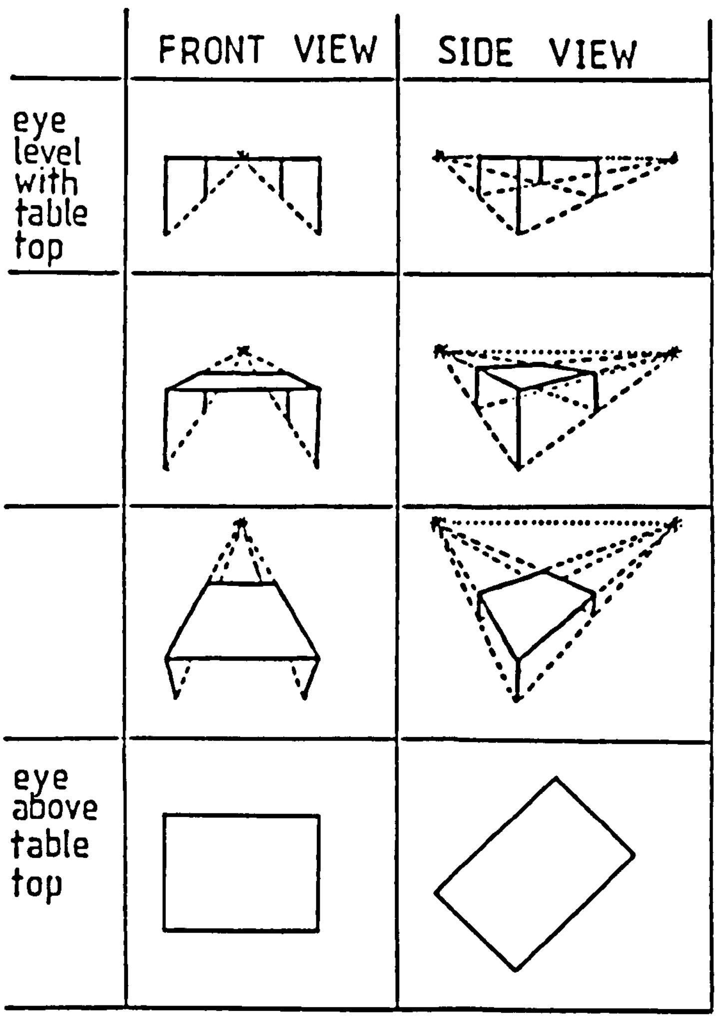
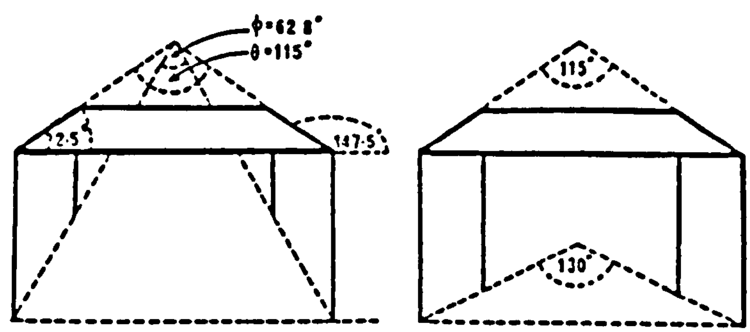


Figure 3:1. *The effect of viewing position upon the ways in which a table can be represented.*

Notice that in this senario the table top is never seen in oblique projection. For this to happen the object would need to be viewed from the side, not the front. The implication of this point is that children appear to go through a period during which they no longer represent the table as if from the position in which they see it, the front, something they have been quite capable of doing before. Instead they adopt an imaginary side view for a while, before reverting to their original practice of representing the table from the correct side. Alternatively, it could be argued that development is related to shifts in the viewpoint, firstly through a vertical rotation, then horizontal, and then back to vertical. If this were really the case the orthogonals should converge in the oblique drawings, producing oblique perspective. Unfortunately the method of classification used by Willats was not sufficiently delicate to pick up possible small convergences in the oblique drawings.



a. CORRECT PERSPECTIVE b. FALSE PERSPECTIVE

Figure 3:2. *The relationship between correct and false perspective.*

These points can be addressed by examining the manner in which the table legs as well as the table top are depicted. This is a major departure from earlier practice and makes it possible to identify the projection system that is being used. For example, an analysis of the table legs would show whether the table really is being drawn from end view or top view (orthographic or vertical oblique projection) Secondly, an analysis of the table legs also makes it possible for us to see whether the subject uses a coherent unified projection system. For example, Figure 3:2a shows a table drawn correctly in perspective. The table top in Figure 3:2b is identical to that of Figure 3:2a and classification based on the measurement of the top alone would place it as true perspective, yet it can be seen that a single, unified, form of projection is not in use.

CLASS of PROJECTION			AGE 6	7	8	9	10	11	12	13	14	15	16	17	
1	none		4	2		1					1				8
2	orthographic	—	2	4	5	3	3	3	5				1	1	26
3	vertical oblique		2	2	1	4	2	3	2	6	2	2	4	2	34
4	oblique						1	1	2	2	3	1	1	2	13
5	naive perspective				1		1	1	1	2	3	6	1	5	21
6	true perspective				1		1				1	1	3		7
			8	8	8	8	8	8	10	10	10	10	10	10	

Figure 3:3. *Data obtained by Willats 1977.*

There are three other areas in which Willats' experimental method might benefit from revision. Firstly, as Figure 3:3 shows, his conclusions were based on data drawn from a sample of only eight or ten subjects of each age, and for each age these drawings are placed into one of six classes. An elbow jogged at the wrong time would make a large difference to his results. When a Kolmogorov Smirnov 2-sample test is applied to the frequencies that Willats obtained for either the use of true as opposed to naive perspective, or to the use of true perspective as opposed to the use of oblique, it can be seen that there are no significant differences between either pair. (Naive versus true perspective: $D = 0.24$, $n = 28$, $p > 0.05$; True perspective versus oblique: $D = 0.26$, $n = 20$, $p > 0.05$).

Given the amount of variation found in children's drawings this subject population is too small to support, confidently, the conclusions that he reached.

The second difficulty is that Willats' experimental task was designed to study both the use of projection systems and the use of partial occlusion simultaneously. This was achieved by requiring children to draw a complicated array of objects upon the table top whilst also drawing the table. The complexity of the task may have detracted from the representativeness of his results.

Thirdly, whilst Willats controlled the overall dimensions of the table, there was variety in the shape and position of the table legs presented to the subjects. The method Willats used for classifying the drawings according to the projection systems used was based wholly on the way in which the table tops were drawn. There was no apparent need for control over the legs of the stimulus table, but lack of control presupposes that any differences in the legs of the tables used as stimuli would not affect the demands of the task. More importantly this assumes that development occurs in the understanding of the use of projection systems rather than, for instance, in the viewpoint from which the object is portrayed, as discussed earlier and illustrated in Figure 3:1. These assumptions were not verified.

Willats' study made a major contribution to the understanding of how depth is represented and also its formal classification. It has been replicated here in a modified form, because of the doubts outlined above. The stimulus table used in the present study was the same for all subjects, thus enabling direct comparison of the way in which the table legs were depicted. The sample size used here is also considerably larger. The results have been examined both in terms of the projection system used and in terms of the understanding shown in its use.

Method.

Subjects. Subjects consisted of 789 children, representing the total intake of one primary school and one secondary school in Leyland, Lancashire. The number of subjects in each age group can be seen in Figure 3:4.

Age	4	5	6	7	8	9	10	11	12	13	14
Subjects	30	30	30	30	30	30	30	147	178	164	90

Figure 3:4. *The number of subjects in each age group.*

Task. Each child was seated at a table facing the long side of a second table measuring 112x56 cm. the child's eyes were approximately 32 cm above the table top and 300 cm away from the facing table. Once settled, the child was given paper and pencil and asked "Please look at the table carefully. Now draw it for me as well as you can." No time limit was given. These conditions are very similar to those used by Willats. Figure 3:2a shows the view of the stimulus as seen by the subject. If a child drew more than one table, it was the first drawn that was measured.

Results.

The raw data obtained in this study can be found in Appendix 6:A. Detailed analyses of this data can be found in other appendices to Chapter 6.

A) General Analysis.

The drawings were assigned to classes according to the projection system in which the table top was depicted. As described earlier, the projection system is partially determined by the angle of convergence of the orthogonals. This value can be obtained by drawing straight lines on the subject's picture along the line representing the front of the table and the lines representing the orthogonals of the table. The angles between these lines are measured and used to ascertain the degree of convergence by taking the smaller from the larger. For example, the table top in Figure 3:2a can be seen to have an angle of convergence of 147.5° - 32.5° = 115°. This is the same method as that used by Willats (1977a). Figure 3:2a illustrates that what is being ascertained is the angle θ made by the orthogonals as they converge to the vanishing point. In accordance with Willats' classification, all responses with a convergence of less than 20 degrees were classified as non-perspective.

All non-perspective responses were classified according to the degree of obliquity shown, which is the mean of the two angles made by the orthogonals. and the line representing the front of the table. For example, in Figure 3:2a the degree of obliquity is:-

$$\frac{32.5+147.5}{2}=90$$

Drawings with zero degrees obliquity were classed as orthographic, those between 0 and 80 were classed as oblique, those between 80 and 100 vertical-oblique, and those over 100 oblique. The margins used by Willats for vertical-oblique were 70° and 110°. The reasons for departing from these margins are discussed later. Figure 3:5 gives the mean age and standard deviation for each class of projection.

Projection	Orthographic	Vertical-Oblique	Oblique	Perspective
No. subjects	89	196	119	385
Average age	7.26	9.08	11.82	12.43
Std. deviation	2.48	2.97	1.62	1.06

Figure 3:5. *The total number of subjects, average age, and standard deviation of age for each class of projection.*

Figure 3:6 shows the distribution of different types of class according to age. The orthographic and vertical-oblique classes show similar patterns of distribution. These two types of response, with age, were significantly correlated ($r = 0.67$, $df = 9$, $p < 0.05$), whilst also showing significant differences ($\chi^2 = 53.15$, $df = 10$, $p < 0.001$). The precise implications are discussed later. The proportion of children that used orthographic projection declined at the age of seven, coinciding with a rise in the use of the oblique response, but the use of both orthographic and vertical-oblique projection remained similar, declining steadily between the ages of ten and eleven. The number of subjects in a particular age group using perspective increased from 3% at ten years old to 80% by the age of fourteen, whilst from 8 years old to adulthood the use of oblique remained at between 15% and 25 %.

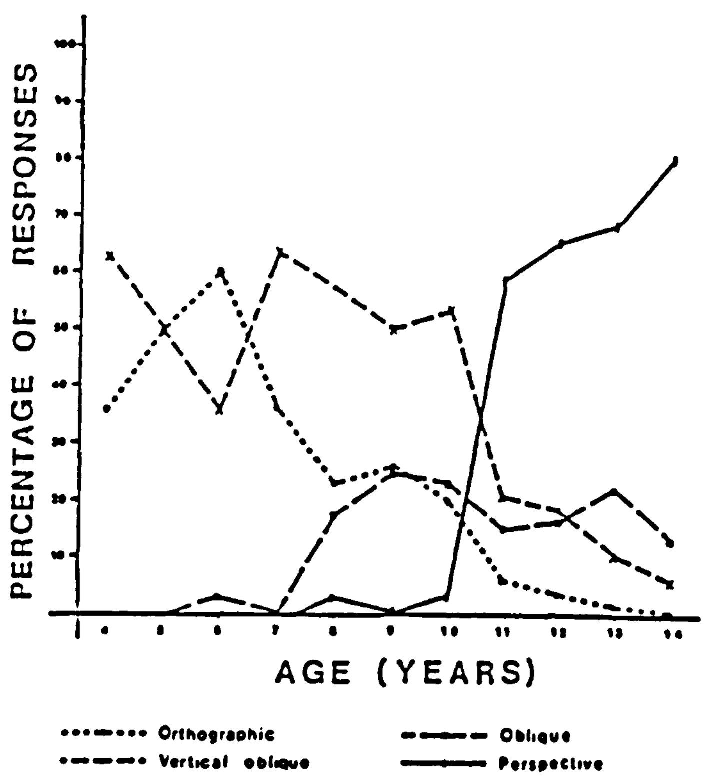


Figure 3:6. The proportions, with age, of response of each class of projection when a table is drawn from observation.

B) Perspective Response.

Willats arbitrarily divides the perspective response into naive and true perspective at 55 degrees convergence. A distinction between naive and true perspective can only be made if the drawing has been done from observation, with a fixed eye-level, as is the case both here and in Willats' study. For this special case such a division would need to be supported by bi-modality in the data, or a relationship between the amount of convergence and the age of the child.

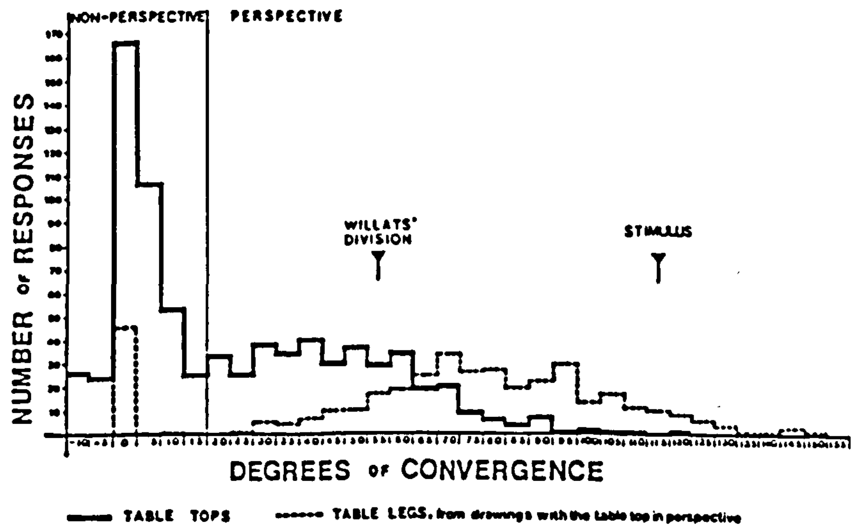


Figure 3:7. *The distribution of the data according to the degree of convergence.*

Figure 3:7, in which frequency scores of the data at intervals of 5 degrees convergence are given, shows no apparent bi-modality. Further, a one-way ANOVA using age (in years) as a grouping factor and degrees of convergence as a dependent variable failed to show that the degree of convergence in which the table top was drawn was affected by age, as can be seen in Figure 3:8. The means upon which this test is based can be seen in Figure 3:10.

Willats (1977a) also found no significant correlation between the angle of convergence and age in his data. It can be concluded that there is no evidence to support a clearcut distinction between naive and true perspective.

The view of the stimulus table that the subjects had was at 115 degrees convergence on the top. All except two of the subjects produced drawings with a convergence on the table top of less than this. None of the subjects used linear perspective that was correct for their viewing position.

SOURCE	:	SS	df	MS	F
AGE	:	2429	3	809.67	2.3
ERROR	:	115126	327	352.07	
TOTAL	:	177555	330		

$F_{.95}\ (3,>200) = 2.6$

Figure 3:8. *A one-way ANOVA using age (in years) as a grouping factor and degrees of convergence in which the table tops were drawn as a dependant variable.*

As mentioned previously, although Willats imposed strict control over the position from which the subjects drew the table and the size of table top the legs of the tables he used varied. In this study each subject was presented with the same stimulus table, and so the depiction of the table legs can be compared across drawings. The degree of convergence shown by the legs in the drawing was measured by joining the drawn base of each front leg with a straight line, and by joining the base of each front leg to the base of the leg 'behind' it by a straight line. The degree of convergence for the legs could then be calculated in the same manner as for the top. Figure 3:2a illustrates that what is being ascertained is the angle φ made by the inferred orthogonals as they converge to the vanishing point, 62.8 degrees in this case. When a table in this position is drawn correctly in perspective (Figure 3:2a) the convergence of the legs should be less than that of the top. A drawing of a table in which the convergence of the legs is the same as or larger than that of the top (Figure 3:2b) is an obvious use of false perspective. In other words, when the table is drawn in correct perspective the legs should be scaled according to the same size-distance rule.

Figure 3:7 shows that the convergence of the legs of those drawings whose tops were in perspective was significantly greater than the convergence shown by the tops. ($t = -21.59$, $df = 331$, $p < 0.05$). In three cases angle φ was 180 degrees, in other words the back legs were extended so far that the table gave the appearance of being on a single ground or base line. Young children do draw to a ground line; however a one-way ANOVA using age as the grouping factor, and degrees of convergence as a dependent variable, given in Figure 3:9, failed to show a significant difference, with age, in the degrees of convergence used. Figure 3:10 shows a comparison of the means obtained in the last two F tests. A perspective response was only produced by two subjects who were less than eleven years of age (eight and ten respectively).

SOURCE	:	SS	df	MS	F
AGE	:	2443	3	814.3	1.5
ERROR	:	177712	327	543.5	
TOTAL	:	180155	330		

$F_{.95}\ (3,>200) = 2.6$

Figure 3:9. *A one-way ANOVA using age (in years) as a grouping factor and degrees of convergence in which the table legs (of drawings with table tops in perspective) were drawn as a dependant variable.*

	11 Years	12 Years	13 Years	14 Years
θ degrees	47.08	47.36	48.48	54.26
φ degrees	84.86	87.19	81.16	80.65

Figure 3:10. *The mean degree of convergence, by age, for the table tops (θ) and the table legs (φ).*

The results for these two children are not included in this table. It is possible that whilst the degrees of convergence shown both on the tops and by the legs are not age related separately, there might be an age related trend in the difference between the two.

A significant difference, with age, is found between the scores for θ and φ when a one-way ANOVA is done with age as the grouping factor and the individual differences between θ and φ as the dependent variable, shown in Figure 3:11. The mean differences between φ and θ for each age group are :- 11 year old = 37.67, 12 year old = 39.89, 13 year old = 33.7, 14 year old = 26.37. A Tukey HSD post hoc test shows a significant difference between the means for the twelve year olds and the fourteen year olds ($p < 0.05$). It would appear that older children have a significant tendency to use similar angles of convergence for both the table top and the table legs. At first sight this appears paradoxical, because φ and θ are dissimilar when a table is drawn in correct perspective, but an examination of the means indicates that, with age, there is a reduction in disparity between the two angles.

SOURCE	:	SS	df	MS	F
AGE	:	7992	3	2664	2.97
ERROR	:	293561	327	897.7	
TOTAL	:	301553	330		

$F_{.05}(3,>200) = 2.6$

Figure 3:11. *A one-way ANOVA using age (in years) as a grouping factor and the difference between φ and θ as a dependant variable.*

Figure 3:12 is a scattergram of φ against θ. It shows that as well as failing to draw the table in correct perspective, the form of table nearly all subjects drew fell in the area above the diagonal AB, an area in which the response is not correct under any circumstances. The problem is complicated by the fact that the relative dimensions of the table may not have been represented accurately. For instance, the form of perspective the child is using might be correct for the shape of the table drawn, even if that table is not an accurate representation of the 'real table' in front of the child. The picture might be internally consistent, but a bad representation. The measures used so far rely upon the child's ability to depict, correctly, the relative dimensions of the table.

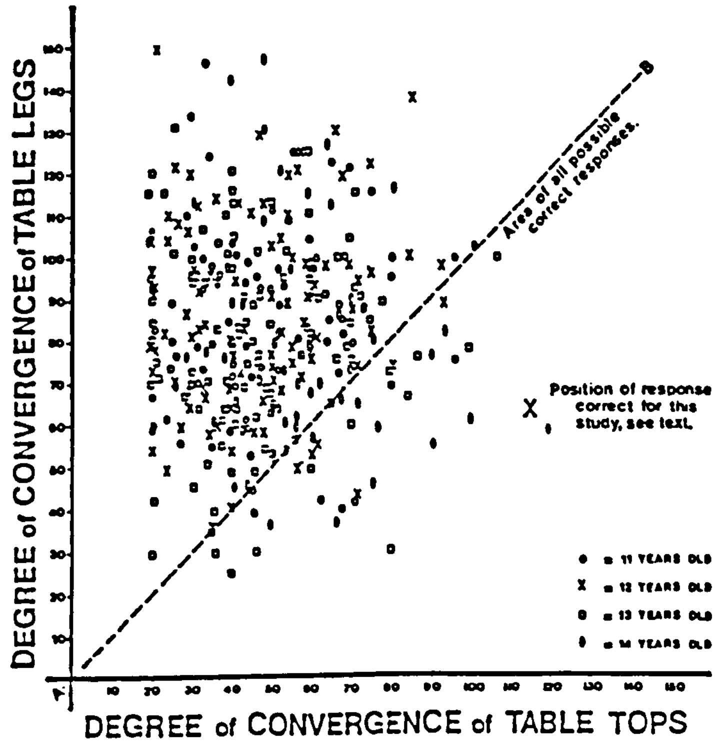


Figure 3:12. *The distribution of θ and φ.*

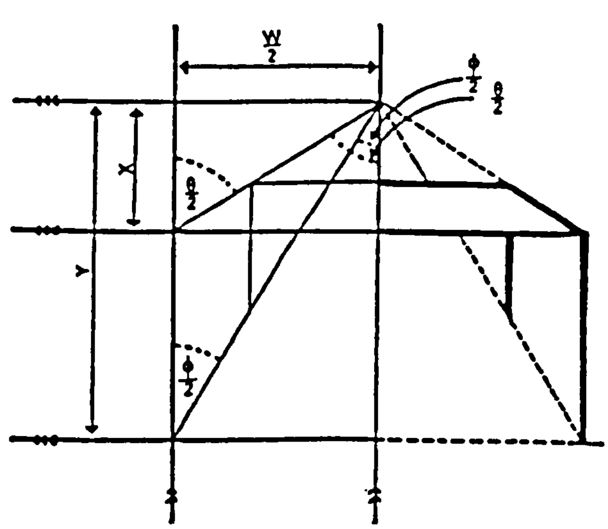


Figure 3:13. *A trigonometric analysis of a table drawn in perspective.*

Figure 3:13 shows a trigonometric analysis of half a table in correct perspective. It can be seen that two vertical parallel lines are crossed at right angles by three parallel horizontal lines. The real orthogonal of the table top, and the implied orthogonal of the table legs combine with these parallels to give two right angled triangles. A trigonometric comparison of these triangles gives a measure of the correctness of perspective used. The logic for this is as follows:- In a table in true perspective, where w is the width of the table, and y -x is the length of the leg (both as measured on the drawing) then:

$$\begin{aligned}\cot\left(\frac{\varphi}{2}\right) - \cot\left(\frac{\theta}{2}\right) &= \frac{2y}{w} - \frac{2x}{w} \\ &= \frac{2}{w}(y-x) \\ &= \frac{2 \times (\text{leg length})}{w}\end{aligned}$$

Therefore each drawing can be given two values. On the left hand side, a value showing the relationship between the angle of convergence in which the table top and the table legs are represented, and on the right a value for the relative dimensions of the table. In practice, the table legs are rarely drawn the same length, therefore height of table is taken to be the mean length of both front legs. Figures 3:2a and 3:2b would be worked as follows:-

Figure 3:2a:-
$$\begin{aligned}\cot\left(\frac{62.8}{2}\right) - \cot\left(\frac{115}{2}\right) &= 1.64 - 0.64 \\ &= 1.00\end{aligned}$$

Figure 3:2b:-
$$\begin{aligned}\cot\left(\frac{130}{2}\right) - \cot\left(\frac{115}{2}\right) &= 0.47 - 0.64 \\ &= -0.17\end{aligned}$$

For both Figures 3:2a and 3:2b:-

$$\begin{aligned}\frac{2}{w}(y-x) &= \frac{2 \times 56}{112} \\ &= 1\end{aligned}$$

Finally, the value P can be obtained for each drawing. This represents the difference between what θ and φ should be, given the dimensions of the picture of the table, and what they actually are. Thus it is a direct measure of the internal consistency on the picture plane of the projection system used (perspective). This is a formal method of classifying tables that are represented as if from a central viewpoint. (Figures 3:2a and 3:2b would have P values of 1.00 −1.00 = 0, and −0.17 −1 = −1.17, respectively.) A table drawn in correct perspective should have a P value as near to zero as possible, constrained by the limits of the measuring equipment. The greater the P value differs from this, the larger the perspective error. Variation of P value within the data was from 0.03 to −5.68. A one-way ANOVA using age (in years) as the grouping factor and value of P as the dependent variable shows that the absolute correctness of perspective used is related to age, as can be seen in Figure 3:14.

SOURCE	:	SS	df	MS	F
AGE	:	15.6	3	5.2	6.17
ERROR	:	275.6	327	0.8	
TOTAL	:	291.2	330		

$F_{.99}$ (3,>200) = 3.78.

Figure 3:14. *A one-way ANOVA using age (in years) as a grouping factor and P value as a dependent variable.*

The mean P for each age was :- 11 years old = −1.8, 12 years old = −1.9, 13 years old = −1.7, 14 years old = −1.5. A Tukey HSD post hoc test showed significant differences between the means for the 14 year olds when compared with those of the 12 and 13 year olds ($p < 0.05$). An examination of the mean value of P for each age group indicates that whilst all children fail to use perspective correctly, the perspective used by the older children is more in keeping with the dimensions of their own drawings than is that of the younger children.

Figure 3:15 shows the data plotted according to the two values used to obtain P. The diagonal C/D in this figure indicates all possible positions of drawings in correct perspective, given variations in the dimensions of the drawn tables. As long as it is the uppermost surface of the table that is being depicted, the only possible correct responses for any shape or size of rectangular table are those to the right of the vertical axis. (Those in which cot ($\varphi/2$) is greater than cot ($\theta/2$)). Under the present experimental conditions point X is the only possible position of the correct response. No subjects achieved it. Allowance

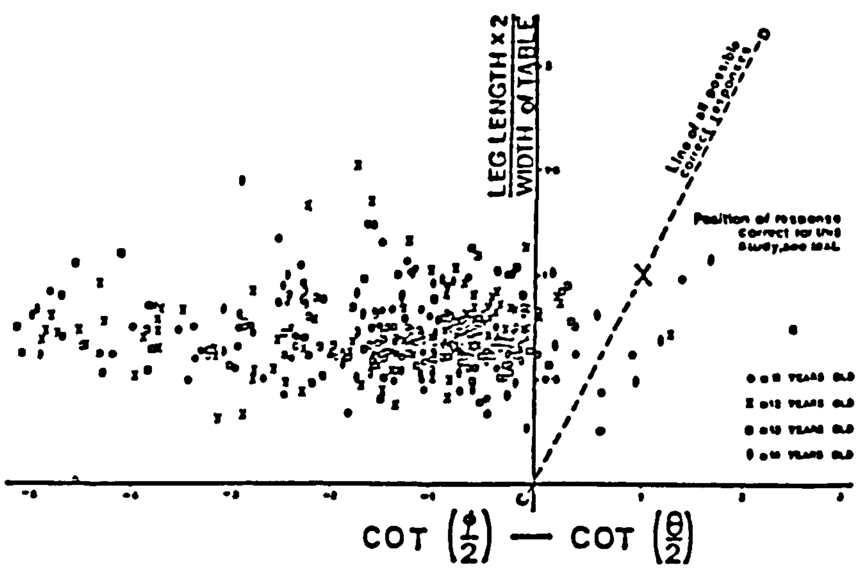


Figure 3:15. *The relationship between age and the ability to reproduce correctly perspective and the relative dimensions of the table.*

needs to be given for graphical error, but note that the error is systematic rather than random, suggesting an incomplete application of the rules of perspective rather than simple error. It can be seen that subjects do not produce correct perspective, and that the degree of incorrect perspective produced is related to age. It is also evident in Figure 3:7 that these children, who all failed to draw perspective correctly, were reasonably good at depicting the relative dimensions of the table, as can be seen in the way most data cluster in a vertical band near to 1.0. There is at most a mild tendency to underestimate the length of leg in relation to table width.

To summarise, those subjects producing a perspective response did not use correct perspective. In each age group there is no distinction between naive and true perspective. The table legs are drawn with a greater degree of convergence than are the tops. No subject produced a form of perspective that was correct for any shape of table, let alone one with the specific measurements discussed here, however the older children were more accurate than the younger ones in their use of perspective.

C) Non-perspective Responses.

Those drawings with less than 20 degrees of convergence on the table top were termed non-perspective, and were classified according to the degree of obliquity shown, as described earlier. Figure 3:7 shows that in approximately five percent of the drawings the orthogonals diverged, rather than converged. Because of the small number of such responses they were not treated as a separate class of projection even though physically impossible in the absence of a model whose back is longer than its front (Hagen 1985), but were included with the other non-perspective responses.

The distribution of non-perspective responses can be seen in Figure 3:16. The margins used by Willats were 70° and 110°. However, as can be seen in Figure 3:16, the limits of 80° and 100° reflect more accurately the discontinuities in the distribution obtained here. This has the effect of marginally increasing the oblique response at the expense of the vertical-oblique. However, as Figure 3:6 shows, the vertical oblique response was found to be much larger than that of the oblique, and so such a narrowing of the class limits does not alter conclusions drawn from an examination of the response in these classes.

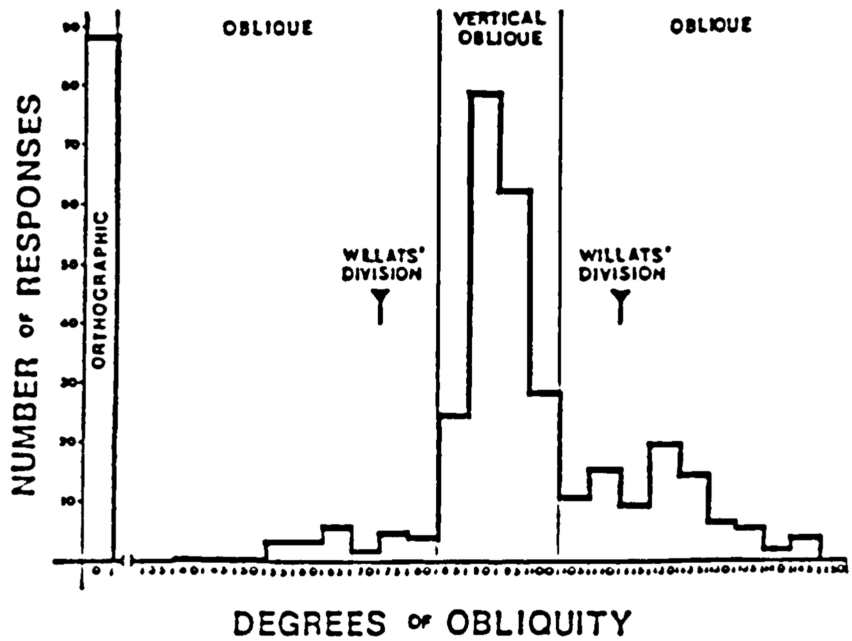


Figure 3:16 *The distribution of data according to the degree of obliquity.*

In Figure 3:1 it was demonstrated that it is possible to draw a table in oblique-perspective, in which the table is shown as if viewed from the side, but with orthogonals that converge. An oblique-perspective drawing with less than 20 degrees convergence would be classed as non-perspective in this study, because correct convergence is considerably less in oblique perspective. This means that some drawings, classed as non-perspective, may actually be in perspective, although drawn as if viewed from the side instead of the front. Theoretically there should be no convergence of the orthogonals in oblique projection. This was not the case for any age group. The mean convergence of the oblique response for each age group was:- 8 Years old = 4.6, 9 Years old = 3.57, 10 Years old = 2.33, 11 Years old = 2.9, 12 Years old = 4.82, 13 Years old = 1.46, 14 Years old = 1.5. A one-way ANOVA using age (in years) as a grouping factor and degrees convergence as dependent variable reveals no significant difference with age between these figures, as can be seen in Figure 3:17.

SOURCE	:	SS	df	MS	F
TREATMENT	:	219.2	6	36.5	0.65
ERROR	:	5915.8	106	55.8	
TOTAL	:	6135.0	112		

$F_{.95}$ (6,106) = 2.25

Figure 3:17. *A one-way ANOVA using age (in years) as a grouping factor and degrees of convergence used to depict table tops drawn in oblique projection as a dependant variable.*

These figures do not rule out the possibility that all children who produce oblique actually use oblique-perspective. However this would appear unlikely. In this study only two children under eleven used perspective, yet eighteen used oblique. This is not consistent with the view that perspective drawn from a central viewpoint is less complex to depict than oblique perspective.

It is possible that both forms of perspective are of equal complexity and that subjects can use either with equal ease. Whilst there was no significant difference found between the age related means for convergence either on the perspective or oblique table tops they are negatively correlated when compared with each other (r = -0.5944). It would appear that the older children produce less convergence when drawing in oblique, and more when drawing in perspective. This suggests that the processes involved in the depiction of the two systems are unlikely to be identical.

The negative correlation cannot easily be explained in terms of the use of oblique perspective, but may be addressed more plausibly by the suggestion that subjects are trying to draw the table top in oblique projection. To do so correctly they would need to produce no convergence. The positive means, even for the oldest children, suggest the existence of some form of figural bias, in which oblique parallel lines, extending from a base line, are drawn as slightly converging. Mitchelmore (1985) argues that younger children are less able than older children at producing two oblique parallel lines. His work concentrates on a younger age range than that discussed here, but it is possible that the trends he identified are still evident, although to a lesser extent, in older age groups. Further research is necessary to clarify this point, but the evidence presented here suggests that subjects are attempting to draw a table top in oblique projection, rather than oblique perspective, and that convergence in the depiction of oblique parallel lines might be attributable to some form of figural bias.

Discussion

This study partially replicated that of Willats (1977a) and found, as he did, that children depict a table top in a variety of ways that can be identified with the orthographic, vertical-oblique, oblique, and perspective projection systems. The major departure from techniques used earlier has been the examination of the way in which the table legs have been depicted as well as, and in conjunction with, the way the table tops have been drawn. In this way it is possible to see if the subject uses a coherent, unified projection system. This has enabled Willats' results to be extended and some of his assumptions to be queried. Further, this study used sufficient subjects to obtain a reasonable distribution. This made it possible to discover in detail how the drawing of a table from observation changes with age and showed that some distinctions previously suggested are not valid.

The results presented here suggest two areas in which the class limits used by Willats require modification. The least important is the narrowing of the band in which a table top would be classed as vertical-oblique. It was shown earlier that such a narrowing of the class limits does not alter conclusions drawn from an examination of the response in these classes.

The second revision, that of amalgamating naive and true perspective, has deeper implications. Theories of drawing that assume that the subject is trying to depict what is seen also assume that the best way of doing this is perspective, and that the subject is attempting to achieve a perspective result. Most importantly they assume that adults do draw in correct perspective. It has been shown here that a distinction between naive and true perspective cannot be supported theoretically or empirically. The representation of depth does not develop from naive to true perspective and thus it may be appropriate to abandon this division in general, and certainly in this specific case.

It has also been shown that the vast majority of subjects who drew a table in 'perspective' drew the legs with more, rather than less, convergence than they had used for the table tops. This is the exact opposite of the response that would be expected from a true understanding of the projection system. The form of perspective they used was verifiably incorrect perspective, not true perspective, according to the formal method of measuring perspective used here, the P value. The P value is a measure of the consistency of perspective used by the subject in relation to the subject's own drawing, not as inferred by the experimenter from the stimulus. When the data are examined in this light a developmental trend is seen, from incorrect to true perspective, according to criteria which are internal to the dimensions of the drawing. The oldest subjects in this study were less than fifteen years old, leaving open the possibility that adults do achieve true perspective. However, as is shown in the next chapter, when a table is drawn from imagination the perspective response peaks at fourteen, which is also the age after which most children in England are no longer required to use it at school.

These findings strongly support the view that whilst most people would agree that perspective is the theoretically correct method by which to depict depth in two dimensions, it is not necessarily the most chosen way psychologically.

In this study the oblique form of projection appears to be qualitatively different from the others. In the oblique system the table is drawn as if seen from the side, rather than as the experimental condition, 'correctly' from the front. Yet in each age group from eight years old to adulthood between 15 and 25 percent of the subjects drew a table in this form. Subjects in this age range are not normally considered so insensitive to the scene as to be incapable of showing the side from which they are in the process of viewing the table. Such a persistent use of oblique was also found by Duthie (1985) and Hagen (1985), and requires some form of explanation. The mean degrees of convergence for each age group of the oblique response is positive, whereas theoretically it should have been zero. However it has been argued that this does not imply that subjects were using some form of oblique-perspective. Instead it has been suggested that this aspect of the oblique response might be a form of figural bias. This leads to a testable hypothesis in a predicted direction and lends itself to further research. However it does not solve the problem of why such a large percentage of older subjects choose to depict the table they can see in front of them from a viewpoint that is inconsistent with their own.

A large amount of overlap was found in the use of orthographic and vertical-oblique projection, and the patterns of response for these two classes correlated significantly. Serious doubt is cast upon the supposition that the use of these two classes indicates separate developmental stages. This doubt is supported here by the observation that those children who did draw more than one table frequently produced tables in both orthographic and vertical-oblique projection side by side on the same page. The ambiguous status of these two forms of projection is emphasised in the next chapter where it is found that a sizable minority of subjects who drew a table in vertical-oblique depicted objects along its top edge. Duthie (1985) reported that there were considerable variations between drawings of the same object by the same child when a child was repeatedly tested. He rejects the view that a child attempts to represent a scene in one particular form of projection. This is supported by data presented in Chapter 6 which shows that when a table drawing that is classed as vertical-oblique on the basis of the way that its top is drawn is examined it is frequently found that the legs are depicted in a manner inconsistent with vertical-oblique projection. As both Phillips *et al* (1985) and Mitchelmore (1985) suggest, it would appear more likely that development is related to the finding and remembering of appropriate graphic descriptions rather than some general and slowly evolving conception of space. Certainly the fact that an experimenter is able to classify a drawing in a particular projection system does not necessarily indicate that the artist intended to use that system, or would use it on all occasions.

To summarise briefly, this study has shown that no subjects drew in correct perspective, that there is no clearcut distinction between naive and true perspective, that the use of oblique projection is qualitively different from the use of the other systems. The study has also cast doubt upon the supposition that orthographic and vertical-oblique projection represent separate developmental stages. These findings suggest that Willats' conclusion that the representation of depth in drawing goes through a series of discrete stages, each of which can be identified with a projection system cannot be supported.

This study indicates the need for further investigation in several areas. Firstly, although the width of the subject base used here is much greater than that used by Willats, there is also a need to extend the range of ages to accommodate the way in which adults depict tables. Secondly, it is possible that whilst the close identification between the understanding of projection systems and discrete stages in the depiction of depth cannot be supported, there is still a general link between the use of projection systems and stages in the depiction of depth. In other words, if subjects use the same sorts of projection systems across all tasks it might be that development can be identified with the use of projection systems, if not the theoretical understanding of them. Therefore there is a need to study the way in which a table is drawn under different conditions. The third point follows from the second. In this study subjects have been presented with a highly constrained task, in which they have been asked to draw from a specific, central, viewpoint. The task demands might thus have forced the covariance of view centred and view specific depiction. It is possible that without such view specific task demands different forms of depiction would have been produced.

In the study reported in the following chapter a wide range of subjects were asked to draw a table from imagination and the way in which projection systems are used under these conditions is compared with the findings given above. The task of drawing from imagination was chosen because it does not entail the need to see a stimulus from a specific view point, whilst allowing subjects utilise a specific viewpoint if they wish.

CONTENTS OF CHAPTER 4.

A Table Drawn from Imagination.

Chapter 4.

A Table Drawn from Imagination.

Summary.

Drawings of a table executed from imagination are compared with those done from observation. Although the majority of older subjects use a form of naive perspective when drawing a table from observation almost all subjects use oblique projection when drawing a table from imagination. The form of projection used by older subjects is thus task dependent, which casts doubt upon the use of projection systems as a developmental measure. Development in the drawing of a table is shown to occur in a similar manner on both tasks when the data are grouped according to the form of natural (as opposed to linear) perspective used. The implications of these findings for research into development of the representation of depth are discussed.

Introduction.

An ideal system for classifying the representation of depth in drawings is one which indicates the level of development reached by the artist. Development predicted theoretically needs to have a close relationship to that found empirically. A satisfactory classification therefore needs both psychological and theoretical validity. The previous chapter showed that there is not a clear link between development in the understanding of increasingly more complex projection systems and development in the depiction of depth. However, in that chapter it was suggested that the empirical evidence does not exclude the possibility of a link between the use of projection systems and development in the depiction of depth, and that there is a need for further study of this area.

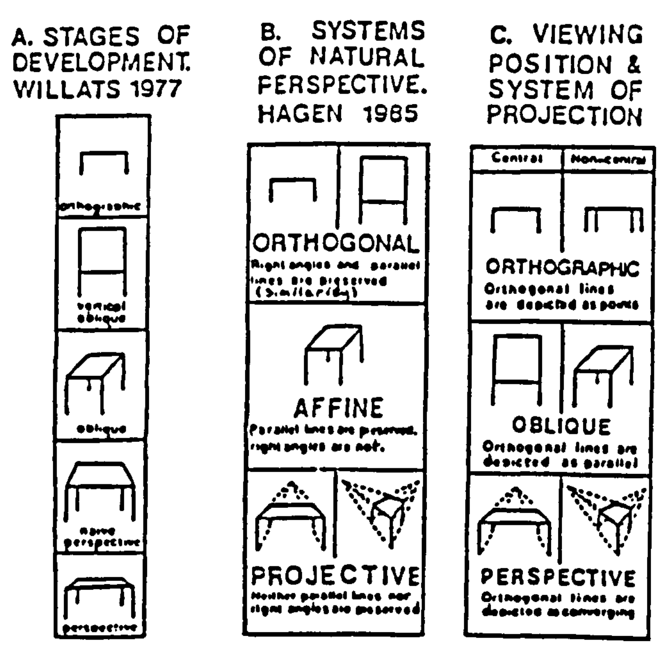


Figure 4:1. A comparison of methods of projection. See text for a discussion about the position of vertical oblique.

The previous chapter concentrated on replicating and analysing Willats' study, and so adopted his form of classification. Hagen (1985), however, cast doubt on the theoretical justification for the form of classification which Willats used. She showed that there are only a limited number of ways in which it is possible to project the surfaces of a three dimensional object in space onto a flat surface, based upon three variables:- whether the object is depicted as if viewed from a single or from multiple station points; the angle at which the object is viewed; the distance the object is from the observer. She argues that all possible conditions of realism are described by only four methods of natural (as opposed to linear) perspective:- orthogonal, similarity, affine, and projective. Figure 4:1 illustrates these and relates them to the stages which Willats proposed.

In orthogonal perspective multiple station points are used and the artist is frontal to the object. Right angles, parallel lines and relative size are preserved by the projection. Willats' definitions of both orthographic and vertical-oblique projection come into this category. The second system, that of similarity, involves a single station point with the artist still frontal to the object. Where the depiction of only one object is concerned this system appears identical to orthogonal, because the depth cue of diminishing size with distance is used only between complete objects. A separate object in the distance is thus shown as smaller than one nearby, but no difference in size is made within an object for distance. As the studies discussed here involve the depiction of only one object it is impossible to distinguish the use of similarity from the use of orthogonal, and so the term orthogonal will be taken to refer to either. The third system, affine perspective, involves multiple station points with the object at an angle to the artist. Parallels are preserved by this projection, but right angles are not. Oblique projection falls into this class. In projective perspective there is one station point and the object is at an angle to the viewer. Parallel edges converge and right angles are lost. This also describes linear perspective. Hagen discusses a further type of drawing, that of divergent perspective. In this the orthogonals are depicted by lines that diverge upwards in the picture plane. This is an 'impossible' form of projection, in that there is no station point, angle, or distance at which the artist could stand to view a regular object in this way, yet Hagen found it to be used quite frequently.

The empirical evidence presented in the last chapter suggests that dividing the forms of projection according to Hagen's systems of natural perspective might have more psychological significance than a division in accordance with Willats' stages of development. Firstly, the use of orthographic and vertical-oblique projection was found to be similar and their use appeared to indicate alternative methods of depiction rather than the discrete developmental stages that Willats suggests. Hagen's orthogonal system does not differentiate between these classes of projection. One difference between her work and that of Willats' is that she found that half her subjects used orthogonal when drawing a house, whereas only a very few of Willats' did. However, the results of both Willats' and Hagens studies, and those of the previous chapter, are compatible if orthographic and vertical-oblique are combined into one category.

Secondly, in the previous chapter oblique projection was seen to hold a unique position, in that it was used by older subjects, although dissimilar to their view of the table.

Thirdly, in the previous chapter no difference was found between the use of naive and true perspective as measured by the angle of convergence. Subjects used a form of naive perspective, in that perspective was not used correctly, but never progressed to true perspective. Here the two categories could be combined into a failed form of projective system of natural perspective.

From this it could be argued that development occurs in the progression from using orthogonal (orthographic/vertical-oblique), to affine (oblique), to projective (perspective). However, Hagen examined the possibility of such development and suggested that this was not the case. She examined the way in which houses were drawn, either from observing models or from imagination, and found that under all circumstances few adults used the projective system of natural perspective. In general she found that the majority of adults used orthogonal perspective. Therefore, from the assumption that if development does occur it will be in terms of increasing view specificity (orthogonal, to affine, to projective) she argues that *"drawing, in terms of systems of spatial representation, does not develop across culture or with increasing age"*.

Hagen's position suffers from several drawbacks. Firstly, she bases her arguments upon the drawing of a house. This is a stimulus that is frequently drawn by young children and so there is a high possibility that their depictions have become stylised, and that the depictions of the older children and adults are still based upon the stylised versions that they produced when younger. Thus the drawing of a house may well not be the best stimulus to use when attempting to assess developmental trends.

Secondly, she gives no details about the shape of the roof on the model house. The implication is that the roof was pitched in some way, as she talks about the depiction of seemingly arbitrary roof shapes. These would be less likely to occur if the model were a simple cuboid. The majority of illustrations she gives of houses drawn from imagination also contain pitched roofs. The increased complexity of having to depict a pitched roof may well have discouraged the subjects from attempting a view specific depiction.

Thirdly, as was shown in the last chapter, it is very hard to differentiate between the use of affine and the use of projective when a house is depicted edge on. However, Hagen does not give details of the level of error she allowed when making such differentiations. Similarly she does not indicate the degree to which all aspects of the depiction have to accord with those of the class into which it is placed.

These three points all indicate that Hagen might have underestimated the subject's ability to depict an object in a view specific manner. However, her arguments directly challenge the view that systems of spatial representation are suitable in some way as a developmental guide, and present us with four hypothetical positions:-

a) That the representation of depth goes through a clear development sequence consisting of discrete stages linked to the use of projection systems.

b) That the representation of depth goes through a clear development sequence consisting of discrete stages linked to the use systems of natural perspective.

c) That the representation of depth goes through some development, but not in the manner or for the reasons stated by Willats or Hagen.

d) That the representation of depth does not develop.

It is possible to disentangle these positions by examining the relationship between viewpoint and view specificity. The way in wnich a table is depicted in a particular projection system depends upon the view-point of the artist, as can be seen in Figure 4:1c.

In Willats' 1977a paper development was seen to be independent of viewpoint. For example, he points out that in his terms oblique and vertical-oblique are not theoretically different systems, but differ in the viewpoint used. From this it follows that oblique projection is not out of place in the developmental sequence he proposed. When viewpoint is considered the high oblique response found in the previous chapter, between 15 and 25 percent of subjects in each age group from eight years old to adulthood, appears anomalous. It can be argued that whilst oblique projection looks as if an oblique viewing point is assumed, it is actually a formal system which could be said to assume a central viewing point or indeed a lack of viewpoint, in that lines in depth are represented by obliques. However, this does not alter the fact that Willats used a task with a central viewpoint to argue that development is indicated by the progressive use of projection systems. Hence, the prediction that a task involving a different viewpoint should elicit the same results is entirely consistent with his theory.

For the sake of argument let us assume that development does occur in the use of projection systems but relate this apparent development not directly to projection systems, but to an increasing ability to specify a unique viewpoint. Depiction will still be analysed in terms of the projection system used, but vertical oblique will be placed beside oblique in Figure 4:1c. In this case a task involving a central viewpoint can be expected to elicit development through orthographic and vertical-oblique to perspective, whereas a non-central viewpoint would be expected to elicit development through orthographic and oblique to oblique-perspective. If vertical-oblique and oblique are alternative methods of depiction, both at the same 'stage', the choice between them being dependent upon the viewpoint, then their use should vary similarly with age.

Alternatively, we could argue that viewpoint is of paramount importance and that there is very little development related directly to the use of projection systems. This places the relationship between oblique and vertical oblique in an ambiguous position. Hagen (1985) sees vertical oblique as equivalent to orthographic projection, and so oblique stands on its own as a system of natural perspective. However, if we wish to trace development in the degree of view specificity that is used, whilst relating it to viewing position, this means that the affine system is only applicable to non-central viewpoints, unless, as suggested above, we argue that affine projection is a special case of depicting a central viewpoint. If so we would expect progression from orthogonal, through affine, to projective, and also expect that a task involving a different viewpoint will elicit a different, view related response.

The above positions both take view specificity to be the end point of development. However, this is not necessarily the case. There might be no development, as Hagen suggests, or there might be development, but towards a different end point. One way of investigating this is to introduce a task in which the viewpoint is left unspecified, such as drawing from imagination. The object can be projected in any way that the artist wishes, and so the artist chooses both the viewpoint from which the object is to be depicted and the degree of specifity of that viewpoint. Hagen asked some of her subjects to draw from imagination, but did not present the findings in a way which enabled the reader to analyse the degree of stimulus view specificity as a separate variable.

In order to evaluate these positions data obtained when a table was drawn from imagination is presented in this chapter and compared directly with that presented in the previous chapter on tables drawn from observation. It was felt that this study would benefit from a larger age range than that used in the previous study. Data from children as young as 2 years 4 months were studied in the hope of identifying earlier systems, and data from adults were studied in order to discover what, if anything, is at the end of the developmental chain. Finally, in order to obtain normative data it was felt important not to constrain the subject's imagination. The findings are discussed in relation to the predictions set out above.

METHOD. Subjects. Subjects were chosen in a way that would give a broad cross-section of the population of Leyland, both in age and ability. 4,056 subjects participated, with an age range of 2 years 5 months to 53 years. The youngest group of subjects, 195 with ages between 2 years 4 months and 4 years 6 months, contained all the children from one state nursery school and the children from three of the four playgroups in operation at the time of testing. 2,313 Infant and Junior school children were used, ranging from 4 Years 7 months to 10 years 6 months old. This represented about 90 percent of the population of Leyland in this age group. 1,443 Secondary school children participated, ranging from 10 years 8 months to 16 years old and drawn from five of the six state secondary schools in the area. 46 subjects, ranging from 16 to 18 years old, were drawn from Runshaw, Leyland's Sixth Form College. Finally, 59 subjects, ranging from 18 to 53 years old, were approached in the streets.

Task. Nursery and Infant school children were seen individually. After an introduction and a chat they were asked to draw a table on a piece of paper in front of them. If the child was reluctant, he/she was asked just to try and do his/her best. Three children refused to co-operate and have not been included in this study. 43 of the subjects were tested whilst there was a table, other than the one on which they were drawing, in the room. However, no child was seen to copy it and it was not indicated in the discussion.

Junior school, Secondary school, and Sixth Form College children were seen as a class. Tables were available in the room and could have been copied. However, it was ensured that all such tables had objects on and around them, and no child was seen to refer to a particular table in drawing. After introductions, pencils and paper were distributed and the children were asked to think of a table and draw it carefully.

Adults were approached individually and were asked to make a line drawing of a table. On several occasions further explanation was needed before the adult would comply. In these cases it was emphasised that there was no 'correct' way of drawing a table, that it was not an intelligence test, and that the subjects' names would not be recorded.

In each case no time limit was given, but all subjects worked quickly, none taking longer than ten minutes.

Results.

The raw data obtained here can be found in Appendix 6:B. Detailed analyses of these data can be found in other appendices to Chapter 6. Before full reporting of the results it is first necessary to explain how the drawings were scored as several forms of drawing were found that have not been mentioned above.

The class of projection in which the table top was depicted was ascertained by the same method as that used in the previous chapter. Briefly, the angles measured were those between the lines in the picture representing the orthogonals of the table and the line representing the front of the table. This enabled the degrees of convergence and obliquity shown in the drawing to be calculated, which in turn enabled the drawing to be classified according to the form of projection shown.

Drawings that could not be classified in this way were produced by 369 subjects, who each drew a table top that was rounded in shape. Figure 4:2 shows the number of subjects in each age group who produced this form of table top. For these drawings the table top was measured across its horizontal and vertical axes. An index of roundness was obtained by dividing the larger number into the smaller. Figure 4:2 also shows these table tops grouped according to their index of roundness. Those tables with an index of roundness greater than or equal to 0.55 were classed as round, whereas those with an index of roundness of less than 0.55 were termed oval. A significant age difference in the production of these two classes is found if the proportions of response, with age, of each class are compared. (χ^2 = 63.73, df = 9, p < 0.001). These proportions of response can be seen in Figure 4:3. Five subjects (mean age 4 years 2 months) produced a table top in the form of a semi-circle. These were classified according to their index of roundness and included in the analysis.

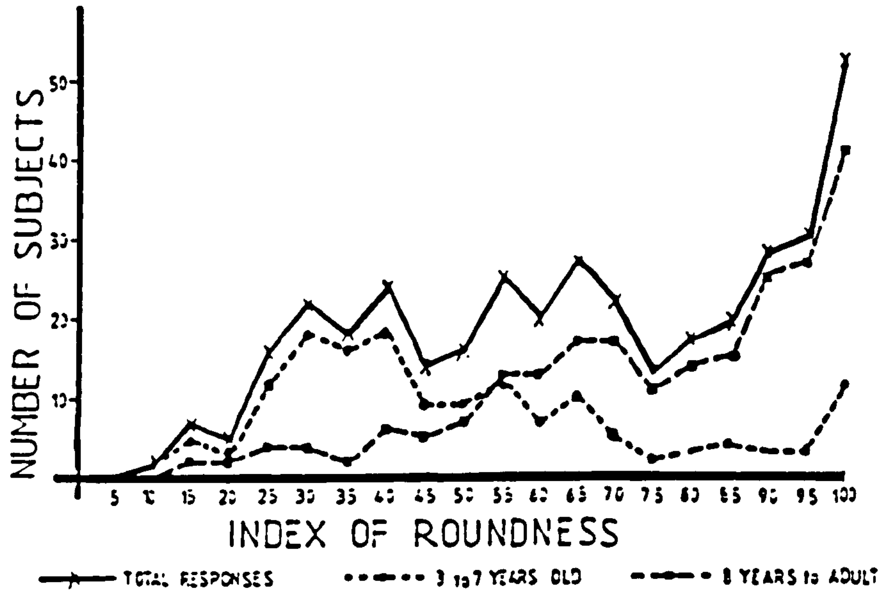


Figure 4 2. *The distribution of data according to index of roundness, in total and with age.*

Twenty two subjects, all less than 11 years old (mean age 8 years 6 months) produced a table top with less than -20 degrees of convergence, thus giving the table top the appearance of divergent perspective. These drawings could be accurate depictions of some tables found in Primary schools which are designed to fit together in groups of six to form a hexagonal island. Because of this and the very small number of subjects responding in this way the drawings were included in the analysis, classed as vertical-oblique.

Fourteen subjects (mean age 5 years 2 months) drew a table top in the vertical-oblique form, but placed objects along the top edge, as if the tables were intended to be orthographic. As this study is concerned with the representation of the table top, the drawings were classed according to the system in which the top itself was drawn.

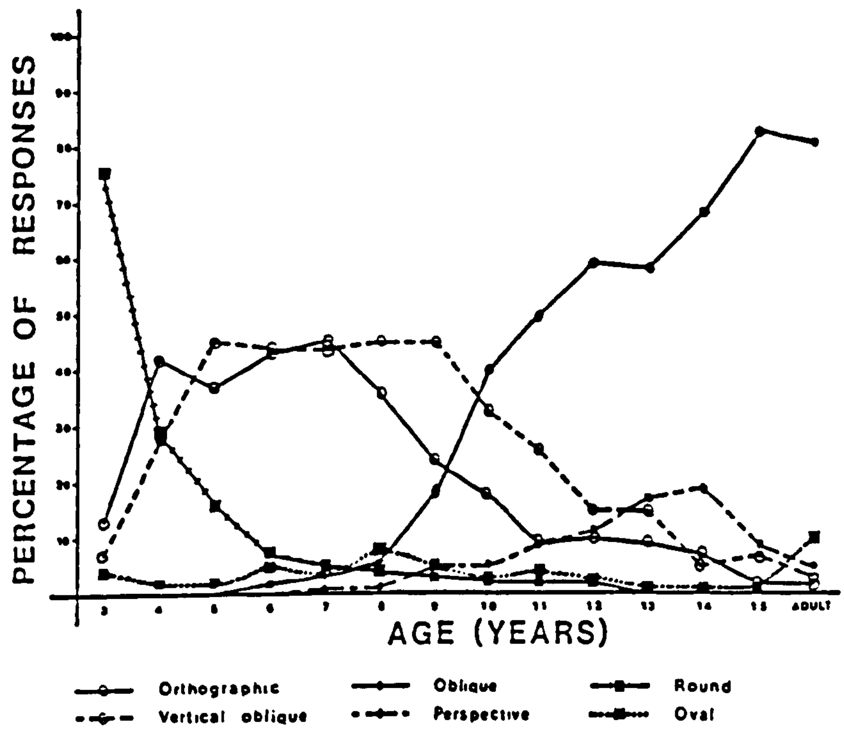


Figure 4:3. The proportions, with age, of responses in each class of projection when a table is drawn from imagination.

Figure 4:3 shows the distribution of different types of class according to age. The majority of very young children used a circle to represent the table top, whilst a small percentage of all age groups produced an oval table. A comparison between the proportion of children in each age group using either orthographic or vertical-oblique projection shows both that there was no significant difference with age in their use, and a high correlation between them. ($\chi^2 = 21.86$, df = 13, $p > 0.05$; $r = 0.85$, $p < 0.001$). Both responses rose to approximately 45 percent at five years old and dropped again at about eight years of age. The perspective response was small, peaking at fourteen years of age when it was produced by 19 percent of the population. The oblique response was used by 6 percent of eight years old, but climbed rapidly to 82 percent by the age of fifteen.

The angle of convergence on the table tops in oblique projection produced by eleven to fifteen year olds was measured in order to see if they were using oblique perspective. True oblique projection would produce zero convergence. The mean degrees of convergence were:- 0.04° at 11 years, 1.04° at 12 years, 1.28° at 13 years, 1.6° at 14 years and -0.06° at 15 years. It can be concluded that the older subjects were not using oblique perspective.

When a table is drawn from observation the predominant form of projection used by the older subjects is a form of perspective, as was shown in the previous chapter. When a table is drawn from imagination, however, the predominant form is oblique. A comparison of the way each form of projection is used, as measured by the proportion of subjects in each age group using it (from four years of age, to fourteen), in this study and that reported in the previous chapter shows significant differences between the two studies. (Orthographic:- $\chi^2 = 19.8$, df = 9, $p < 0.02$; Vertical-oblique:- $\chi^2 = 17.61$, df = 10, $p < 0.1$; Oblique:- $\chi^2 = 52.75$, df = 8, $p < 0.001$; Perspective:- $\chi^2 = 36.71$, df = 7, $p < 0.001$). The data used for this comparison can be found in Appendices 6:A and 6:B. From this it can be seen that the nature of the task, either drawing from observation or from imagination, has a great effect upon the class of projection that is used.

Figure 4:4 illustrates a comparison between the two studies in the use of a central viewpoint. This measure was obtained by combining the responses for vertical oblique projection and perspective. As discussed above, orthographic can indicate several different view points, either central or to one side, and oblique indicates a non central viewpoint. A comparison between the two studies shows that there was little difference in the proportion of younger children using either vertical-oblique or perspective responses on either task ($\chi^2 = 6.61$, $df = 5$, $p > 0.2$). It was not until about ten years of age that the children started to show a more central, and hence more accurate, viewpoint when drawing from observation.

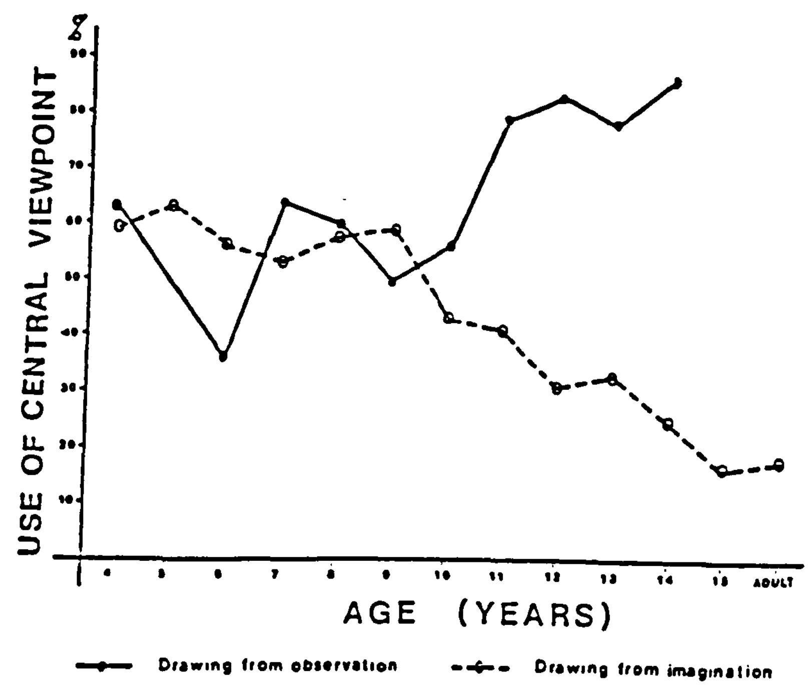


Figure 4:4. The proportions, with age, of responses indicating a central viewpoint when a table was drawn either from observation or imagination.

Figure 4:5 illustrates strong similarities between the two studies if the responses obtained in them are grouped according to whether they are orthogonal (orthographic, vertical-oblique, and round) or non orthogonal (oval, oblique, and perspective). χ^2 tests failed to find any significant differences between the two studies in the proportions of children in each age group using either orthogonal or non orthogonal systems of natural perspective (Orthogonal:- $\chi^2 = 13.31$, $df = 10$, $p > 0.02$; Non orthogonal:- $\chi^2 = 9.92$, $df = 6$, $p > 0.1$). Thus there would appear to be a strong developmental trend that is not reflected in the use of each class of projection on its own, but is revealed by this division of the data.

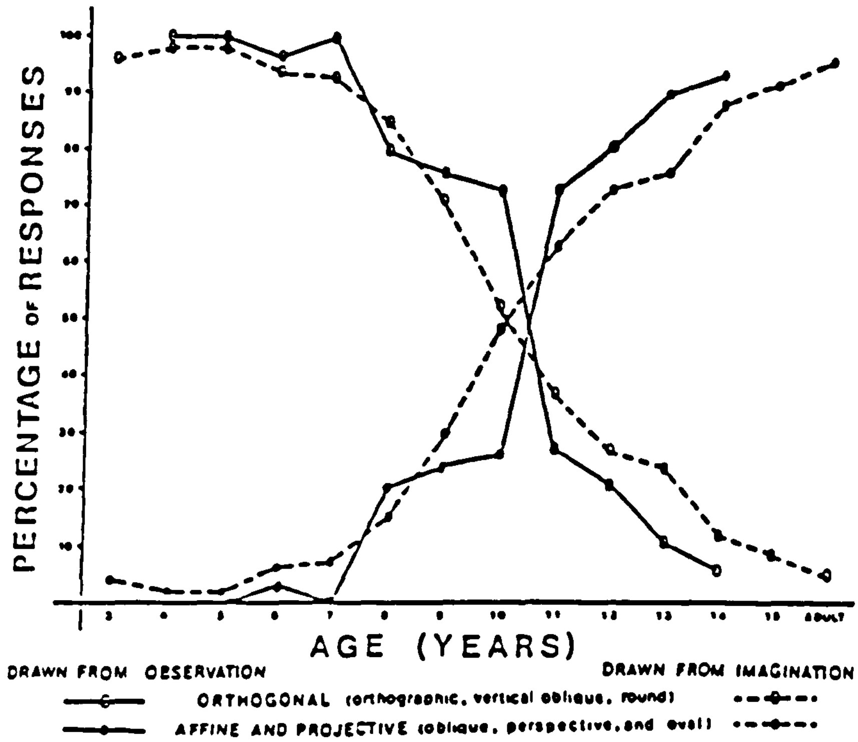


Figure 4:5 The proportions, with age, of orthogonal and non orthogonal responses when a table was drawn either from observation or imagination.

Discussion.

Both the wider age range and the task of drawing from imagination produced a more varied response than was found in the earlier study. It was necessary to add two further classes to the classification of the table tops, round and oval. One form of depiction, in which a table is drawn as vertical-oblique but with objects placed upon the top edge, merits further discussion. Willats (1977a), whose stimulus included objects on the table, found that some tables were drawn in this manner. That it happens at all and in particular that it happens here, where the inclusion of objects was not required, indicates that the distinction between the orthographic and the vertical-oblique classes might not be as clear cut psychologically as Willats suggested. This is strongly supported by the closeness of correlation and lack of significant difference in the use of the two classes. Therefore the amalgamation of these two classes of projection into Hagen's one system of orthogonal is supported both theoretically and psychologically. Theoretically the classes of round and oval projection do not fit into this group as they do not have actual parallel lines or angles, only inferred ones. However, as described earlier, round can be seen as similar to vertical-oblique (a circular table top seen from above), and oval can be seen as similar to either oblique or perspective (a circular table top with some form of deformation). This classification breaks down if the subject was actually trying to depict an oval table top. However, the effect that this potential area of error might have on the findings is minimal because of the very small number of responses involved.

One of the principal results from this study and the one reported in Chapter 3 is that adults generally use a form of perspective when drawing from observation but use oblique projection when drawing from imagination. This does not fit comfortably with the theoretical work of either Willats or Hagen. Both are founded upon assumptions that development during childhood is towards an endpoint which is the manner of depiction adopted by adults. In Willats' case this is linear perspective, and in Hagen's case it is view specificity.

It is possible that older subjects would prefer to use linear perspective when drawing from imagination but use oblique projection instead because a table in perspective is 'harder' to draw, and so they do not achieve the view specificity that they are aiming for. However, the majority of older subjects finished their Art education at fourteen, and had been taught perspective, yet very few subjects used perspective and none used oblique perspective. Indeed the peak in the perspective response occurs at fourteen years of age. It would appear that once the subjects were no longer required by their schools to draw in this manner the number of perspective responses dropped rapidly. This point is examined in more detail in the following chapter, however, the data under discussion here indicate that development in depiction is not directly related to an increasing ability to specify a unique viewpoint.

The lack of task dependency shown by the younger subjects in the use of projection systems suggests that such subjects are insensitive to viewpoint. The response indicating a central viewpoint used by the younger subjects, that of vertical-oblique, did not follow the pattern shown by perspective. In Willats' analysis vertical-oblique is a special form of oblique, differing from oblique only in the centrality of viewpoint required. As such, it could be expected to occur at the same time as oblique. However the vertical-oblique response was found to be used frequently by the younger children in this study. It could be argued that young children must therefore be highly sensitive to viewpoint and show a greater desire than adults to depict a more central viewpoint. However, Figure 4:4 shows that this possible sensitivity to viewpoint is not task related. Until the age of ten the nature of the task makes little difference to whether the child indicates a central viewpoint. The data indicate that young children produce one form of oblique without simultaneously producing a more general form and are insensitive to viewpoint. Orthographic and vertical-oblique are used as alternative forms of projection, both when the child draws from observation and from imagination. Therefore it cannot be concluded that development occurs in a way that is strictly related to the required viewpoint.

Figure 4:5 indicates that whilst the selection of a particular projection system is partially task dependent there is also an underlying trend common to both drawing from imagination and observation. This form of development only becomes apparent when the data are split into groups in a manner which, in the light of Willats' projection system theory, is entirely arbitrary. The data suggest that children first develop the ability to draw in an orthogonal manner, and later in an affine or projective way, depending upon the task.

To conclude, the finding that adults use different systems as alternative methods of depiction depending on the task, where these alternatives occupy different stages in the proposed developmental sequences, reduces the usefulness of these theories in explaining development.

A more helpful theory would be one which isolates aspects of development which are independent of the task. The following chapters are concerned with identifying task-independent factors.

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Chapter 5.

Aspects of the Task Causing Task Dependency.

Summary.

The four studies reported in this chapter examine the hypotheses that the task dependency shown in the previous chapter is related to either knowledge of projection systems, artistic ability, salience of background, or specification or centrality of viewpoint. They show that task dependancy does not appear to be related to any of these.

Introduction.

The previous two chapters have shown that older subjects depict a table in a task dependent way. When they are asked to draw a table from observation the majority use perspective, but when drawing from imagination the majority use oblique projection. The present chapter examines possible causes of this task dependency.

The two tasks differ in a variety of respects, each of which might have contributed to the task dependency. It is possible that oblique projection is an easier system to use than perspective, and that drawing from imagination is a harder task than drawing from observation,leading to the subjects using the easier system. The first study reported here examines this hypothesis by asking artists to draw a table from imagination. The assumption is that artists are sufficiently skilled to be able to use either perspective or oblique projection with equal ease. Therefore, even if drawing from imagination is more difficult than drawing from observation, they should have sufficient skill to be able to cope with the task without having to revert to an 'easier' form of projection.

Another possible difference between the two tasks is that drawing from observation somehow calls to mind the subject's knowledge of perspective. The assumption here is that subjects have available to them the ability to use either form of projection, and so the task dependent behaviour is in some way related to the way in which the subject interprets the task. This difference in interpretation could be related to several factors. One possibility is that the subject might have previously learnt that when drawing from observation one uses perspective, and so he or she thinks in terms of perspective when presented with an observation task, but is less likely to do so when asked to draw from imagination. This is examined in the second study.

A second possibility is that the difference in interpretation could be related to external factors, in particular those of salience of background and position of the viewpoint. Drawing from observation is qualitively different to drawing from imagination. The object is seen as it stands in real life, on a real floor, with real walls and ceiling round it, and in real juxtaposition to other objects. When drawing an object from imagination it is only necessary to, in some way, form a cognitive map of that object as if it were floating in a void. In both cases the end result might well be a depiction of an object unconnected to anything else, but we cannot assume that the processes involved in reaching these two end states are similar. There are two variables involved here, salience of background and uniqueness of viewpoint.

Drawing from observation entails specification of a viewpoint which in turn dictates, to a large extent, specification of a background. It is, however, possible to alter the salience of the background. As Pratt (1985) explains, experienced artists have a long history of using aids to de-emphasise the three-dimensionality of a scene that they wish to draw, thus facilitating the correct use of perspective. He argues that figure/ground separation is a major factor in failure to accurately reproduce a scene, and so methods that increase figure/ground integration aid analysis of scenes for depiction. The third study examines the effects of bringing the background to the attention of the subject, and of requesting that the observed scene, rather than just the object, is drawn. Similarly, the fourth study examines the effect of an imagined scene upon a table drawn from imagination.

Uniqueness of viewpoint is the final variable identified here. When drawing from observation the subject sees the object from one particular viewpoint, but this constraint is not apparent when a table is drawn from imagination. In the previous chapter the tasks of drawing from imagination and observation varied both in specification of viewpoint and in centrality of viewpoint. As it is difficult to think of an observation task in which the viewpoint is not specified, a more realistic alternative is to encourage subjects to attempt to specify a viewpoint in an imagination task. The fourth study was designed to assist with this investigation.

Study 5: 1.

A table drawn from imagination by people trained in Art.

Introduction.

In the introduction it was suggested that the task dependency might be caused by subjects finding it harder to draw from imagination, and so, if oblique projection were an easier system to use, they might use that instead of perspective when drawing from imagination. The present study examines this hypothesis by comparing the way that 'normal' subjects draw a table from imagination with the way in which adults who have been trained in art and who use art as part of their daily lives perform the same task. It is reasonable to assume that such artists do not find drawing a table in perspective so much harder than drawing one in oblique projection.

Method.

Subjects. 90 adults participated in this experiment. The subjects in Condition 1 (artists) consisted of 45 adults who either taught art in the North-West or were students at art college in the North-West, all of whom intended to become professional artists. The subjects in Condition 2 (non artists) consisted of 45 adults with no artistic training, matched to subjects in condition 1 for age and sex.

Task. Each subject was given a pencil and paper and asked to make a line drawing of a table. This replicates the experimental method used in Study 4.

Results.

A breakdown of the data can be seen in Figure 5:1

Number of S's.	Orthographic	V/ Oblique	Oblique	Perspective	Round.
Artists	0	0	38	2	5
Non artists	1	0	39	3	2

Figure 5:1. *The number of artists and non artists responding in each form of projection when asked to draw a table from imagination.*

Drawings done by the artists were all noticeably neater and more professional than those from the non artists. For instance, nearly all included shading and texture cues. However a Kolmogorov Smirnov χ^2 approximation test comparing the data obtained under the two conditions failed to find any significant differences in the number of subjects using each form of projection. ($K\chi^2 = 0.98$, $df = 2$, $p > 0.5$) Similarly $K\chi^2$ tests comparing the data obtained under each condition with that obtained from adults in drawing from imagination in the previous chapter failed to show any significant differences in the number of subjects using each form of projection. (Artists vs. adults in Chapter 4: $K\chi^2 = 0.32$, $df = 2$, $p > 0.5$. Non artists vs. adults in Chapter 4: $K\chi^2 = 0.32$, $df = 2$, $p > 0.5$).

Discussion.

The results show that artistic training has very little effect upon the way in which people draw a table from imagination. The vast majority of artistically trained subjects, to whom drawing objects and scenes in different forms of projection is an integral part of their livelihood, represented a table drawn from imagination in oblique projection. The amount of detail most of these subjects provided implied that they were not choosing oblique projection because it offered the least amount of effort, and suggests that there might be other reasons for this choice.

Study 5: 2

Drawing a table from imagination after a lesson in perspective.

Introduction.

The previous study has shown that the task dependency identified in Chapter 4 cannot be entirely attributed to possible differences in the degree of difficulty both in the task and in the form of projection used. The subjects did not choose to use an easier form of projection (oblique) because the task (drawing from imagination) was harder. However it might be that, whilst subjects have available to them the ability to use either form of projection, drawing from observation somehow calls to mind the subject's knowledge of perspective. The present study looks at the possibility that the subject might have previously learnt that when drawing from observation one uses perspective, and so he or she thinks in terms of perspective when presented with an observation task, but is less likely to do so when asked to draw from imagination. This was done by teaching the subjects how to use perspective, ensuring that they could use perspective correctly when drawing a cuboid from imagination, and then immediately asking them to draw a table from imagination. The assumption was that the use of perspective when drawing from imagination would then be uppermost in their mind, thereby minimising any possible task dependency related to a cognitive set that mediated against using perspective whilst drawing from imagination, whilst also ensuring that all subjects were able to draw in perspective.

Method.

Subjects. 303 subjects, of 11, 12 or 15 years of age, taken from a secondary school in Leyland, Lancashire, were used in this study. These age groups were chosen because the topic of perspective was introduced in art lessons at thirteen years of age and reinforced at fourteen years of age, both in this school and in other schools in the area. Therefore eleven to twelve year old children were able to examine older children's work on display and a few might have tried to emulate it, and might even have received some tuition at home, but they had not received any formal tuition at school. Fifteen year old subjects were also used because by this age the majority no longer did any art. Although they had been taught perspective previously none claimed to use it. The subjects were assigned to one of two conditions (taught perspective or control), balanced across age, ability and sex.

Task. One of two qualified Art teachers, one of whom was the author, saw each child under the taught condition for a two hour period. In this time the fundamentals of perspective were explained and each subject was taught how perspective could be used to represent a scene (involving roads or train tracks going into the distance) and objects within that scene, both from a central frontal viewpoint and from the side. The teacher ensured that an approximation of a cuboid was obtained from each child, drawn from imagination and as a single object not in a scene, in frontal and oblique perspective. Immediately after this the subject was asked by the teacher to make a line drawing of a table.

The control subjects were seen in the same room, with the occasional drawing in perspective on the walls, though none that had been done by the subjects in the taught condition. Each subject was given pencil and paper and asked to make a line drawing of a table.

Results.

A summary of the data can be found in Figure 5:2.

Kolmogorov Smirnov χ^2 approximation tests on the number of subjects using each form of projection on the table tops were used to compare the two conditions in each age group. Each test failed to show a significant difference across conditions. (11 Year olds: $K\chi^2 = 1.03$, df = 2, $p > 0.5$. 12 Year olds; $K\chi^2 = 1.21$, df = 2, $p > 0.5$. 15 Year olds; $K\chi^2 = 0.88$, df = 2, $p > 0.5$.)

Number of S's.	Orthographic	V/ Oblique	Oblique	Perspective	Round.
Taught Perspective					
15 Years	0	3	43	3	
12 Years	3	12	37	4	1
11 Years	5	17	25	5	2
Control Group					
15 Years	1	4	20	4	
12 Years	10	12	31	12	
11 Years	2	13	29	4	

Figure 5:2. *The numbers of subjects, with age, who had been taught perspective, and those in the control group, responding in each form of projection when asked to draw a table from imagination.*

It is possible that because the two conditions were run in the same school information about the lesson in perspective was passed to pupils who were about to become control subjects. However $K\chi^2$ tests between either condition and the data obtained for those age groups in Chapter 4 failed to show any significant differences. (Chapter 4 vs. drawing a table from imagination after a lesson in perspective: 11 Year olds: $K\chi^2 = 0.5$, df = 2, $p > 0.5$. 12 Year olds: $K\chi^2 = 1.45$, df = 2, $p > 0.5$ 15 Year olds: $K\chi^2 = 1.32$, df = 2, $p > 0.5$. Chapter 4 vs. drawing a table from imagination without a lesson in perspective: 11 Year olds: $K\chi^2 = 0.47$, df = 2, $p > 0.5$. 12 Year olds: $K\chi^2 = 0.77$, df = 2, $p > 0.5$. 15 Year olds: $K\chi^2 = 0.14$, df = 2, $p > 0.5$). Therefore it is unlikely that these subjects and this particular school provided a biased sample.

Discussion.

Subjects were shown to be moderately able to draw a cuboid in perspective from imagination, and the study was designed to increase the salience of this condition immediately prior to the task, yet this knowledge did not affect the form of projection that they used when drawing a table from imagination. These results, therefore, fail to give support to the idea that perspective is in some way less available to the subject when drawing from imagination, and suggest that even when perspective should be uppermost in the subject's mind the subject does not choose to use it when drawing from imagination.

These results also give further support to the suggestion that task dependency is not related to regression to an easier form of projection because of the difficulty of drawing from imagination.

Study 5: 3

Drawing a table from observation against a squared background.

Introduction.

The previous studies have shown that the task dependency identified in Chapter 4 cannot be accounted for, in its entirety, by differential ease in the use of oblique or perspective, or by the way in which subjects might fail to have mechanisms for drawing in perspective uppermost in their mind when drawing from imagination.

In the introduction to this chapter it was suggested that drawing from observation is qualitively different to drawing from imagination. Drawing from observation entails specification of a viewpoint which in turn dictates, to a large extent, specification of a background when drawing a scene. It was suggested that a greater proportion of responses might be in perspective if subjects were asked to draw a table within a scene, rather than as a single object. This study and the following one both examine the effects of bringing the background to the attention of the subject, in drawing from observation and imagination respectively.

The present study concentrates on an observation task. A simple squared background was chosen for this task, rather than a background of objects in the room, for two reasons. A squared background gives a greater element of control over the task. If subjects had been asked to draw a more varied background they might easily have become side tracked into aspects of depiction that were irrelevant to the task. Secondly, a squared background gives help in emphasising the visual appearance of the table. Subjects could, if they wanted, draw the squares and then find the visually realistic shape of the table by noting which parts of the squares were occluded. This process is similar to one used with art college students, in which they are asked to draw the gaps between objects rather than the objects themselves in order to encourage them to perceive the scene in 'two dimensions'.

Method.

Subjects. Chapter 3 showed that development in the use of perspective is most rapid at about eleven or twelve years of age. For this reason the subjects chosen for this experiment were 100 children aged between 11 years six months and 12 years six months. The children were taken from a secondary school in Leyland and were divided into two groups, balanced across sex, ability, and age.

Task. Subjects in the first group were given a task identical to that described in Chapter 3. Briefly, they were placed directly in front of a table and asked to draw it from observation. The instructions used were "Please look at the table carefully. Now draw it for me as well as you can." The stimulus and procedure were different for the second group. They were placed in the same position in front of an identical table, but directly behind the table was a ten foot square backdrop with a bold squared pattern upon it. The backdrop was stretched out in such a manner that the subject could work out the apparent dimensions or retinal image of the table by plotting the pattern. The subject's attention was drawn to this by saying "Look at the squares. Can you see the shape the table makes against them?" and then the subject was asked to draw both the backdrop and the table together by saying "Please look at the table and the background carefully. Now draw them for me as well as you can."

Results.

An analysis of the data obtained in this study can be found in Figure 5:3.

A Kolmogorov Smirnov χ^2 approximation test comparing the two groups failed to find any significant difference in the numbers of subjects using each form of projection. ($K\chi^2$ = 0.64, df = 2, p > 0.05.) Similarly $K\chi^2$ tests comparing these results with those obtained in Chapter 3 failed to find any significant difference in the number of subjects using each form of projection. (With Background vs. 12 year olds in Chapter 3: $K\chi^2$ = 3.41, df = 2, p > 0.05; Without Background vs. 12 year olds in Chapter 3: $K\chi^2$ = 2.61, df = 2, p > 0.05).

Number of S's.	Orthographic	V/ Oblique	Oblique	Perspective.
With Background.	4	13	9	24
Without B'ground.	0	13	12	25

Figure 5:3. *The numbers of subjects responding in each form of projection when asked to draw a table from observation, either with or without a squared background.*

It is possible that whilst the introduction of a background did not affect the proportionate use of the different classes of projection, it did cause the degree of perspective used to alter. However this was not found to be the case. A two-sample χ^2 comparing the degrees of convergence used on the table tops in the two groups failed to find a significant difference. (χ^2 = 2.29, df = 6, p > 0.05). Similarly a two-sample χ^2 comparing the degrees of convergence used on the table legs in the two groups failed to find a significant difference. (χ^2 = 10.34, df = 8, p > 0.05). Finally a two-sample χ^2 comparing the degrees of convergence used on the table tops in the without background group with those used in Chapter 3 also failed to show a significant difference. (χ^2 = 7.23, df = 6, p > 0.05).

All subjects who were requested to draw the background as well as a table drew the pattern on the background accurately.

Discussion.

This study has shown that making the relationship between a table and its background more salient does not effect the way in which eleven to twelve year olds represent the table when drawing it from observation. Tests failed to find any significant differences in the way the table was drawn, either between the groups in this study or between each of these groups and that reported in Chapter 3.

Although subjects examined the squared backdrop, as shown by their ability to draw it accurately, they did not relate its depiction to that of the table placed just in front of it. This dichotomy is an important one. It indicates that although the table is being drawn from observation as part of a scene it is still being drawn as a separate object. The training exercise described earlier, of drawing the gaps between the objects, is difficult to do but often works well because the objects themselves are not being drawn. An informal study of twelve year olds who were asked to draw the gaps but not the table indicated that under these conditions the outline of the table was in perspective. An interesting line of research would to be to explore the implications of this informal study. For the present it is concluded that the way in which a single well known object is drawn from observation is not significantly affected by the salience of the background.

Study 5: 4.

A table drawn from imagination with differing amounts of background depth.

Introduction.

It has been suggested that because, when drawing from observation, the object is viewed as part of a scene the subject relates the object to its surroundings and, even though the surroundings are not drawn, their proximity alters the way in which the subject depicts the object. Study 5:3 showed that increasing the salience of the observed background had little effect upon the method of depiction. This study examines whether this is also the case when a table is drawn from imagination.

When drawing from observation the subject sees the object from one particular viewpoint, but this constraint is not apparent when a table is drawn from imagination. It is hypothesised that by encouraging subjects to create a detailed visual image, before asking them to draw it, the specification of a unique imaginal viewpoint might be enhanced. It is also hypothesised that the further away the table is, within this visual image, the less it might be imagined as a 'table' and the more it might be imagined as part of a scene. This study observes the effect that increasing the subject's concentration upon the background scene has upon the method of depiction.

Finally, in the previous chapter the tasks of drawing from imagination and observation varied both in specification of viewpoint and in centrality of viewpoint. This study also observes the effect of asking subjects to adopt a central viewpoint when imagining the table.

Method.

Subjects. The subjects used were 814 eleven to fourteen year olds, taken from a secondary school in Leyland, Lancashire. They were divided into four groups, balanced across age, ability and sex.

Task. Each group was assigned to one of four conditions: 1) *Control*, in which subjects were asked to imagine a table facing them. 2) *Far*, in which subjects were asked to imagine a countryside scene in which there is a very large field in the distance, in the centre of which there is a table facing them. 3) *Medium*, in which subjects were asked to imagine that they are standing beside a field with a table facing them in the centre of it. 4) *Near*, in which subjects were asked to imagine themselves in a room in which there is a table facing them.

The age group within each condition was seen as a class. Subjects were given pens and paper, they were asked to sit quietly, with their eyes closed and the senario was described to them. They were then asked to open their eyes and draw what they were imagining.

Results.

An analysis of the data obtained in this study can be found in Figure 5:4.

All subjects depicted the scene expected of them. Subjects under conditions 2, 3, and 4 all used the depth cues of diminishing size with depth, height in picture plane and occlusion and in an appropriate manner in their scene. Four sample χ^2 examinations of the table tops between conditions, for each age group, failed to show any significant differences in the number of subjects using each class of projection. (11 Years old: $\chi^2 = 14.2$, $df = 9$, $p > 0.1$; 12 Years old; $\chi^2 = 14.4$, $df = 9$, $p > 0.1$; 13 Years old: $\chi^2 = 8.5$, $df = 9$, $p > 0.3$; 14 Years old: $\chi^2 = 5.5$, $df = 9$, $p > 0.7$). Although subjects are quite capable of depicting different depths of imaginary scene there is no apparent difference in the form of projection with which they depict a table within the scene.

Number of S's.	Orthographic	V/ Oblique	Oblique	Perspective	Round.
1:Control.					
14 Years	0	1	14	12	
13 Years	2	2	40	13	
12 Years	10	9	30	12	
11 Years	2	12	29	3	1
2:Far.					
14 Years	1	1	13	9	
13 Years	2	4	31	11	
12 Years	6	7	29	6	
11 Years	3	5	36	4	
3:Medium.					
14 Years	2	2	12	13	
13 Years	2	7	29	13	
12 Years	2	14	33	11	
11 Years	1	8	26	15	
4:Near.					
14 Years	4	3	14	15	
13 Years	1	9	32	19	1
12 Years	2	8	38	12	
11 Years	4	5	27	12	

Figure 5:4. *The numbers of subjects, with age, responding in each form of projection when asked to draw a table from imagination under near, medium, far and control conditions.*

Kolmogorov Smirnov χ^2 approximations were used to compare, by age, the number of subjects using each projection system obtained from the control groups with the responses obtained from subjects of the same ages in Chapter 4. All the tests failed to show any significant difference in the use of projection system across conditions, though it is worth noting that the older the group the nearer the test was to significance. (11 Years old: $K\chi^2 = 0.46$, $df = 2$, $p > 0.05$. 12 Years old: $K\chi^2 = 0.74$, $df = 2$, $p > 0.05$. 13 Years old: $K\chi^2 = 4.2$, $df = 2$, $p > 0.05$. 14 Years old: $K\chi^2 = 5.3$, $df = 2$, $p > 0.05$).

Discussion.

When drawing a table from imagination subjects do not alter their drawings significantly if the relationship between the table and the background is made more salient. The backgrounds used in this study were drawn accurately according to the conditions of the task, but the form of projection used for the drawing of the table was unaffected by this. This supports the findings of the previous study that increasing the salience of the background has no effect upon the form of projection used. It also extends these findings by showing that they hold even when the table is drawn in the far distance and the vast majority of the depiction is dedicated to drawing the scene around the table.

Encouraging subjects to spend some time visualising the scene before drawing it does not appear to increase the specification of view, as measured by the way in which the table is depicted. Although subjects produced detailed scenes, using the depth cues of height in the picture plane, diminishing size with distance and partial occlusion, they did so in a view centred rather than a view specific way.

Finally this study showed that whilst the tasks of drawing from observation and imagination gave differing results in terms of the position of the subject's viewpoint, the position of viewpoint was not sufficient to account for the task dependency found earlier. Subjects used the same form of projection when drawing from imagination, whether using an unspecified viewpoint or when asked to use a central viewpoint.

General discussion.

The studies presented in this chapter investigate the task dependency found in the way in which in older children use projection systems. When subjects drew a table from imagination they used oblique projection, yet they used perspective when drawing from observation. It was hypothesised that the two tasks differ in a variety of respects, each of which might have contributed to the task dependency. It could be that oblique projection is an easier system to use than perspective, and that drawing from imagination is a harder task than drawing from observation, leading to the subjects using the 'easier' system. However both studies 5:1 and 5:2 suggest that this is not the case. These studies showed that the majority of both artists and subjects who were known to be able to draw in perspective still drew a table from imagination in oblique perspective.

Study 5:2 also investigated the possibility that drawing from observation somehow calls to mind the subject's knowledge of perspective. It was suggested that the subject might have previously learnt that when drawing from observation one uses perspective, and so he or she thinks in terms of perspective when presented with an observation task, but is less likely to do so when asked to draw from imagination. However it was found that the majority of subjects still used oblique projection when drawing a table from imagination, even after having just completed intensive training in using perspective when drawing from imagination.

It was suggested in the introduction that task dependency might be related to salience of background and position of the viewpoint. However both studies 5:3 and 5:4 indicated that increasing the salience of background, whether drawing from observation or imagination, has little effect upon the forms of projection used. Study 5:4 also showed that position of viewpoint did not account for the task dependency found.

Studies 5:3 and 5:4 indicated that even when subjects were asked to draw the object as part of a scene they still drew it as a separate object within the scene, rather than as a collection of lines that contributed to the scene as a whole. For example, in Study 5:3 there was no difference, as measured by the degrees of convergence used by subjects, between the way in which a table was drawn from observation 'normally' and the way in which it was drawn under conditions which emphasised the background. Similarly, in Study 5:4 the table was drawn in a view centred way regardless of the imagined distance from the viewer. These points suggest that there might be another factor underlying the task dependency found in the previous chapter that ties in with the points made about view centred as opposed to view specific representation in Chapters 1 and 2.

It is possible that because we perceive a table in an object centred way we also attempt to draw it in this way. We might be able to perceive and imagine detailed backgrounds, but the importance of figure/ground separation might limit the extent to which these backgrounds impinge upon the way in which we understand the task of drawing the object. We might be able to draw a table in either oblique projection or perspective but because we think of the table in an object centred way we normally use a view centred depiction (oblique) with which to represent it, and the need for a view specific depiction is low on our list of priorities. It may be drawing from observation emphasises the need for a view specific depiction sufficiently to encourage some of us to attempt to draw in perspective. It is, however, worth remembering here that no subjects produced an accurate view specific depiction under any of the experimental conditions. Possibly the perceived need for a view specific depiction might not be linked to aspects of the way in which the object itself is perceived when observing it (ie. salience of background) but may be linked to the perception of the task. In other words it is the task of having to draw the table as it is seen that emphasises the need for a visually realistic depiction.

These speculations are included here as one possible way in which the task dependency found earlier and the findings reported in this chapter can be accounted for. They need to be examined in more detail, however, before they can be accepted or rejected. They assume that a table in oblique projection is the schematic description preferred by most subjects. Chapters 7 and 8 address this assumption directly. Before this, however, it is necessary to examine in detail the manner in which the representation of depth in table drawing develops. Without this knowledge it would be difficult to evaluate studies in the later chapters. The following chapter concentrates on ways in which the representation of depth in the depiction of a table develops independent of the task.

CONTENTS OF CHAPTER 6.

Classification of Table Drawings and the Use of Depth Cues.

Chapter 6.

Classification of Table Drawings and the Use of Depth Cues.

Summary.

This chapter presents an analysis of the data obtained when a table was drawn from imagination or from observation, classified both in terms of the projection system used and in terms of the way in which the table legs are depicted. It is argued that when these two methods of classification are used together they give an indication of the way in which depth cues are used and it is shown that an analysis of this gives a measure of development that is stable across both similar and dissimilar tasks. It is suggested that this method of classification has both psychological and theoretical validity, and is a better measure of development in the representation of depth than is one based directly upon the use of projection systems.

Enlarged versions of Figures 6:1 to 6:8 can be found in the appendices to this chapter.

Introduction.

Previous chapters have shown that there is task dependency in the use of projection systems, and that because of this they are not a particularly reliable measure to use in order to examine general development in the depiction of depth. For example, the studies reported earlier indicate that it is unwise to assume that when children and adults do not use a more advanced form of projection system it is because they are unable to use it, and, conversely, that when children and adults do use an advanced form of projection they fully understand it.

It was also found that there are aspects of development in the drawing of a table that are independent of task. This chapter examines these in more detail, but before that can be done it is necessary to develop a formal system of classification that removes, as far as possible, the subjective elements associated with the analysis of drawings.

The need for a lack of subjectivity was discussed earlier. It was suggested that ascertaining exactly what the subject meant to depict is a general problem with most young children's drawings. It was also suggested that a system of classification needs to be developed prior to the formation of links between a theoretical stance and the empirical evidence.

This chapter presents such a system of classification for the drawing of tables. The classification system is then applied to the empirical evidence and developmental trends that are independent of task are identified. The problems of interpretation are addressed, but the effects of individual differences are minimised by the use of a large subject pool. Some aspects of this chapter are complex and a lot of material has been placed in appendices in order to avoid burying the main results in a mass of detail.

A) CLASSIFICATION OF TABLE DRAWINGS.

The following method of classification makes use of the way in which table legs are drawn. A drawing of a table top on its own cannot indicate the use of occlusion, and it was shown in Chapter 3 that when the use of diminishing size with distance is examined it is important to include an analysis of the way in which the legs are drawn. The proposed method of classification has no integral developmental implications, but will be used later to examine developmental trends.

The drawings are initially classified according to the form of projection in which the table tops are represented. This has been fully explained in Chapters 3 and 4. Each drawing is then classified according to the number, length, and relative positions of the legs, and whether the subject failed to use hidden line elimination. In this way a grid of cells is formed with type of table top along one axis and type of table legs along the other. This can be seen in Figure 6:1.

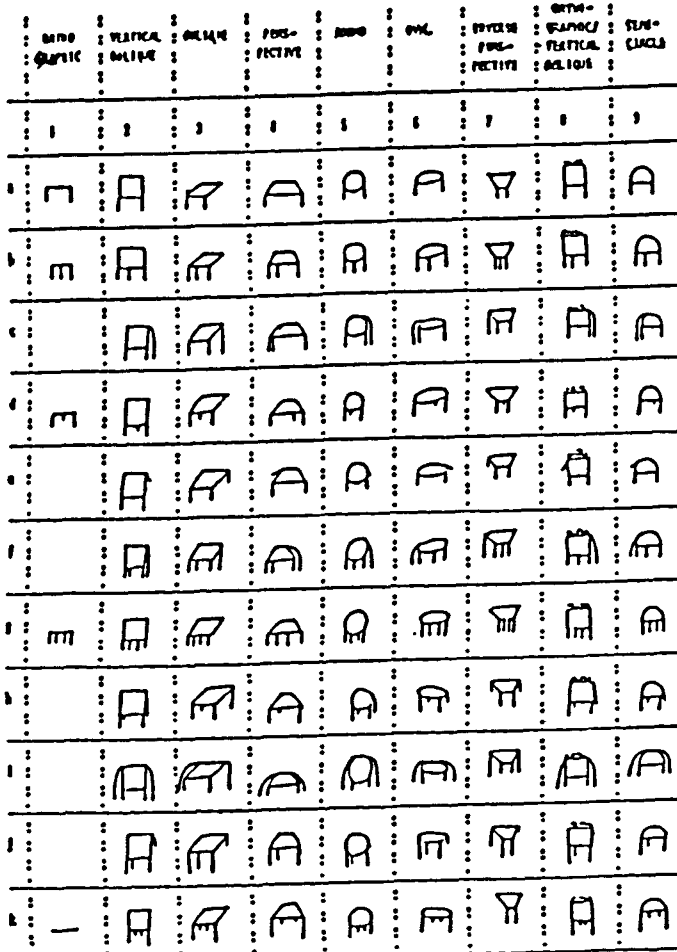
This method of classification has been used on all the data presented in this thesis. It has only been found to be inapplicable to six drawings. Initially all possible combinations of line were considered, but it was found that many cells in the grid were not filled. Empty rows in the grid have not been included for simplicity.

Two major sets of data are examined in this chapter. These were provided by 789 subjects, with ages ranging from 4 to 15 years, who drew a table from observation, and 4056 subjects, from 2 to 53 years of age, who drew a table from imagination. These data were initially presented in Chapters 3 and 4 respectively, and are detailed in Appendices 6:A and 6:B. Figure 6:2 summarises the data according to the classification set out above. The numbers in each cell are divided into three columns. The first and second columns detail responses for the observation task and imagination task respectively. The third column is the total response for

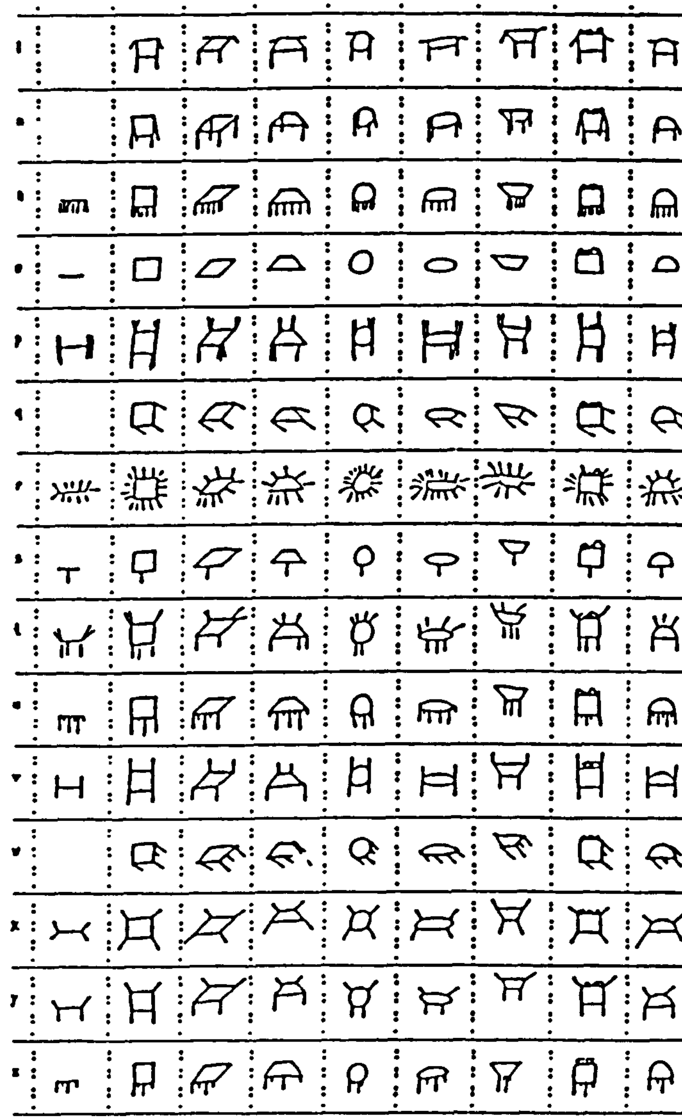
Figure 6:1. *A classification system for table drawings.*

The drawings can be given a sub-class related to the way in which the legs are drawn. Classification is done visually according to the following table.

Basic graphic 1	Vertical oblique 2	Oblique 3	Perspective 4	Round 5	Oval 6	Reverse perspective 7	Orthographic/vertical oblique 8	Semi-circle 9	Description



	Description
a	Two legs are drawn, one from each front corner
b	A third leg is drawn between the first two, all end level.
c	A third leg is drawn from the back, outside the first two.
d	The third leg is between the first two, and ends higher in the picture plane.
e	The third leg comes from the back, outside the first two, ends higher in picture plane.
f	As b but fourth leg comes from back, outside others, all end level.
g	All four legs come from the front line and all finish level.
h	The four legs are equal length, and come from the corners, four vertical with one leg inside
i	As c but the fourth leg comes from the back, outside the others, all finish level.
j	As d but the fourth leg comes from the back, ending higher than the other back leg
k	The back legs come between the first two and are shorter.



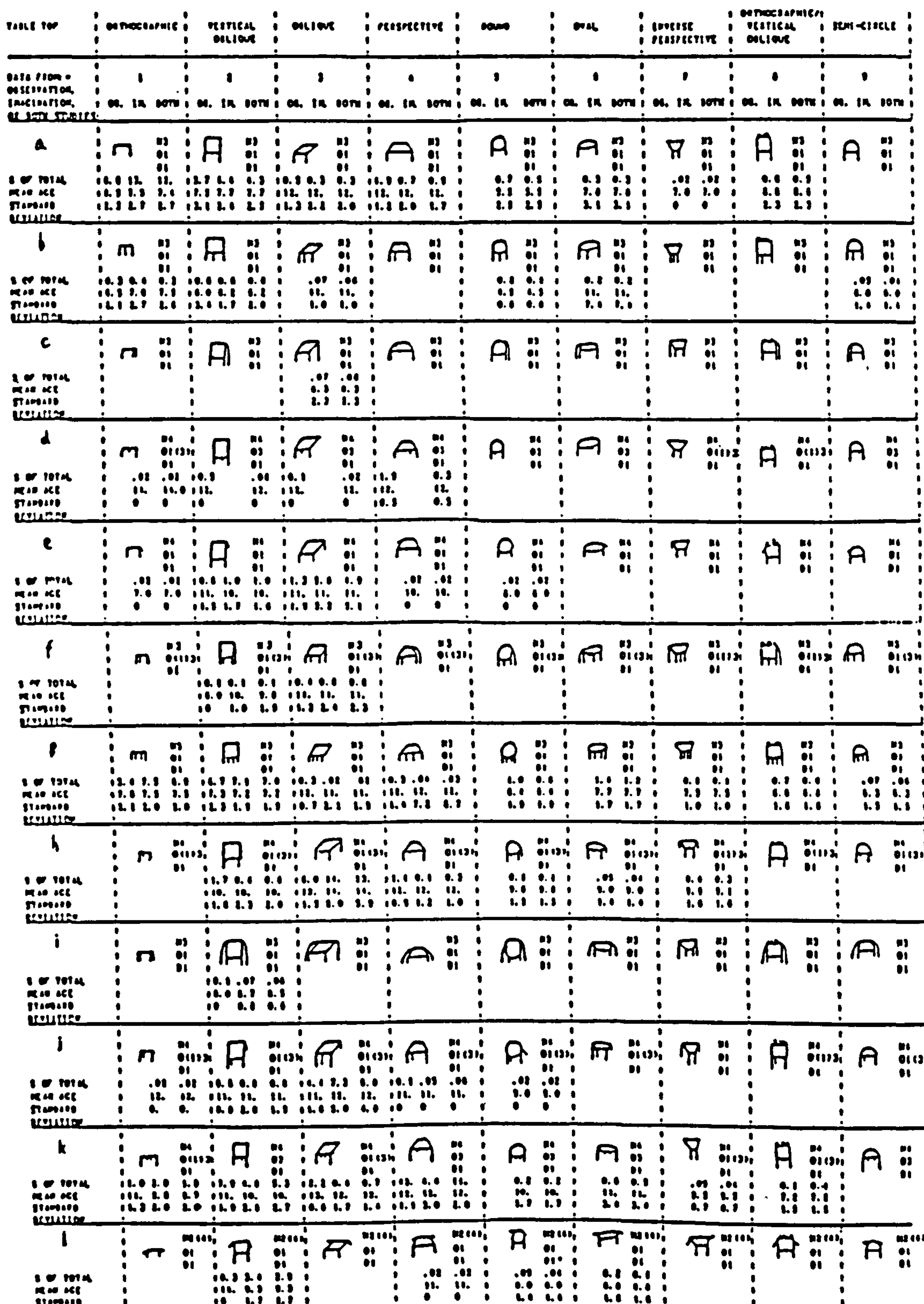
	Description
l	As h, but the back two legs drawn outside the figure are not vertical.
m	As h, but drawn as a transparency.
n	As g, but with more than four legs.
o	Only the top of the table is drawn.
p	As e, but with more than four legs.
q	As e, but the legs are drawn on the diagonal.
r	As x, but with more than four legs.
s	A single leg from the center
t	As y, but with more than four legs.
u	As g, but with more than four legs.
v	The four legs come from the corners, as straight lines either vertical or horizontal.
w	As q, but fourth leg as in j.
x	The four legs radiate from the corners.
y	The four legs come from the corners, the back two radiate whilst the front are vertical
z	The four legs come from the front edge and are alternate long and short.

that cell formed by amalgamating the responses for both tasks. In each column the first row gives the responses in that cell as a percentage of total responses for the task (observation, imagination or amalgamated), the second gives the mean age of subjects giving that response and the last gives the standard deviation of these ages.

Deriving percentage, mean age and standard deviation figures for each cell is quite complex because of the differing number of subjects in each age group and for each task. It is for this reason that the data are presented in two ways: in Appendices 6:A, 6:B, and 6:C they are presented as a percentage of the grand total for each task and in Appendices 6:D, 6:E, and 6:F as a percentage for each year, for each task. In order to give an overall view the numbers in Figure 6:2 use the proportions of responses accounted for by each cell, for each task over all age groups. The figures to the right hand side of each illustration refer to the depth cues used in each illustration and are discussed in detail later in the chapter.

Whilst summarising the data this figure does not show the age profiles for each cell. For example, subjects in both tasks might have responded in a particular cell, and the mean ages for both tasks might be similar, but the age profiles and standard deviations might vary widely. It is important to pick up on this because it might imply that the responses in that particular cell had been driven by different, task related, cognitive processes. For example, if we look at cell 1a we can see that 6.6% of subjects drew in this way from observation, and 13% from imagination. The mean ages were 6.5 and 7.5 respectively. However, we cannot, from these, judge what the age profiles might be. It might be that a small percentage of all subjects at all ages use this form of depiction when drawing from observation, whereas when drawing from imagination only

Figure 6:2. *Classification of data discussed in this chapter. See text for details.*



indication of development. If the age profiles of 1a and 1b are very similar we can conclude that subjects use these two methods of depiction as alternatives. Using this we can examine the degree of similarity between each type of depiction, and so construct a dendrogram of the closeness of similarity of the age profiles of the cells, which in turn will provide information about development. Thus development in use of each form of depiction, on each task, will be analysed by comparing the age profiles, by task, for each cell. A series of Kolmogorov-Smirnov two sample analyses were used to construct a dendrogram for each task. In order to do this the age profile of every cell was compared with that of all the others, then the two cells with the smallest maximum difference (hence the greatest similarity of profile) were amalgamated and the process was repeated until a hierarchical smallest maximum difference had been obtained for all the cells within the data. The resulting dendrograms are complex and are given, along with the information necessary for their construction, in Appendix 6:D (Observation data) and 6:E (Imagination data). Simplified versions based only on cells which account for 0.5% or more of the total response for each task are also given in these appendices.

The order in which the cells in a pair (or triplet, etc.) first enter the dendrogram is random. This order was adjusted so that it was common over the two tasks. There are seventeen cells which each account for more than 0.5% of the task total and which are common to both tasks. The order in which these cells occur in the dendrogram, after the minor harmonisation of the dendrograms mentioned above, can be compared statistically. Each cell was ranked according to its constrained position in the dendrogram. The correlation between the rank orders is highly significant ($r = 0.99$, $df = 15$, $p > 0.001$). The correlation is absolute if cells accounting for more than 1% of the task total are compared. This implies that whilst there are task related differences the overall pattern of development in the types of tables produced varies little across the two tasks. This is perhaps best explained with a practical example. If we examine the 3h response we can see that the percentage of the total for observation and imagination are 6% and 14% respectively, the mean ages are 12 and 14 respectively, and the standard deviations are 1.5 and 6 respectively. The difference between the age profiles for this form of depiction on the two tasks is significant at the 0.01 level. The position of this form of depiction is, however, very similar in both dendrograms. The task might affect the number of responses, and the age at which these responses occur, but it also affects all the other forms of response in a similar way. The relationship between one form of response and another is generally undisturbed.

The dendrograms do not make this point particularly clearly, as they are hard to comprehend without detailed examination. They suffer from a further drawback in that a cell accounting for only 0.5% of the data is given equal weighting to one accounting for 15% of the data. Such problems can be partially overcome by presenting the data in the form of a Venn diagram, containing only one axis, in which the degree of preference is roughly reflected by the size of the illustration for that cell. The information given in Appendices 6:B and 6:C is given in the form of Venn diagrams in Figures 6:3 to 6:6. Whilst this is more helpful conceptually, accurate references must be taken from the dendrograms.

A comparison of Figures 6:3 to 6:6 shows that whilst the range of responses obtained when a table is drawn from imagination is wider than that obtained when a table is drawn from observation the overall pattern of development in the two tasks appears similar. There appears to be little difference between Figures 6:3 and 6:4, the large and small Venn diagrams for the observation task. There is, however, interesting variation between Figures 6:5 and 6:6, the large and small Venn diagrams indication of development. If the age profiles of 1a and 1b are very similar we can conclude that subjects use these two methods of depiction as alternatives. Using this we can examine the degree of similarity between each type of depiction, and so construct a dendrogram of the closeness of similarity of the age profiles of the cells, which in turn will provide information about development. Thus development in use of each form of depiction, on each task, will be analysed by comparing the age profiles, by task, for each cell. A series of Kolmogorov-Smirnov two sample analyses were used to construct a dendrogram for each task. In order to do this the age profile of every cell was compared with that of all the others, then the two cells with the smallest maximum difference (hence the greatest similarity of profile) were amalgamated and the process was repeated until a hierarchical smallest maximum difference had been obtained for all the cells within the data. The resulting dendrograms are complex and are given, along with the information necessary for their construction, in Appendix 6:D (Observation data) and 6:E (Imagination data). Simplified versions based only on cells which account for 0.5% or more of the total response for each task are also given in these appendices.

The order in which the cells in a pair (or triplet, etc.) first enter the dendrogram is random. This order was adjusted so that it was common over the two tasks. There are seventeen cells which each account for more than 0.5% of the task total and which are common to both tasks. The order in which these cells occur in the dendrogram, after the minor harmonisation of the dendrograms mentioned above, can be compared statistically. Each cell was ranked according to its constrained position in the dendrogram. The correlation between the rank orders is highly significant ($r = 0.99$, $df = 15$, $p > 0.001$). The correlation is absolute if cells accounting for more than 1% of the task total are compared. This implies that whilst there are task related differences the overall pattern of development in the types of tables produced varies little across the two tasks. This is perhaps best explained with a practical example. If we examine the 3h response we can see that the percentage of the total for observation and imagination are 6% and 14% respectively, the mean ages are 12 and 14 respectively, and the standard deviations are 1.5 and 6 respectively. The difference between the age profiles for this form of depiction on the two tasks is significant at the 0.01 level. The position of this form of depiction is, however, very similar in both dendrograms. The task might affect the number of responses, and the age at which these responses occur, but it also affects all the other forms of response in a similar way. The relationship between one form of response and another is generally undisturbed.

The dendrograms do not make this point particularly clearly, as they are hard to comprehend without detailed examination. They suffer from a further drawback in that a cell accounting for only 0.5% of the data is given equal weighting to one accounting for 15% of the data. Such problems can be partially overcome by presenting the data in the form of a Venn diagram, containing only one axis, in which the degree of preference is roughly reflected by the size of the illustration for that cell. The information given in Appendices 6:B and 6:C is given in the form of Venn diagrams in Figures 6:3 to 6:6. Whilst this is more helpful conceptually, accurate references must be taken from the dendrograms.

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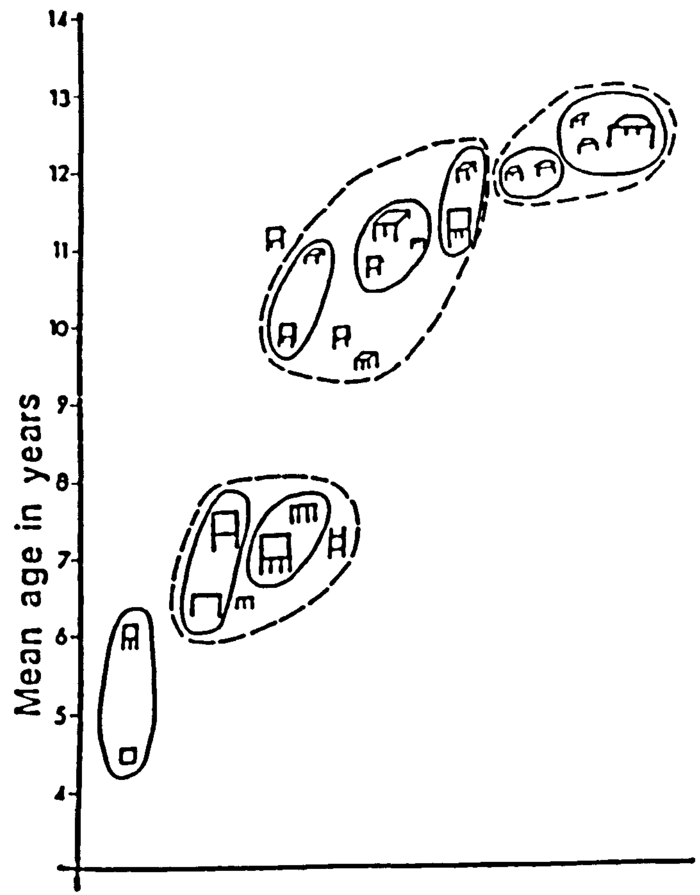


Figure 6:3. *Details of dendrogram for cells accounting for more than 0.5% of all tables drawn from observation.*

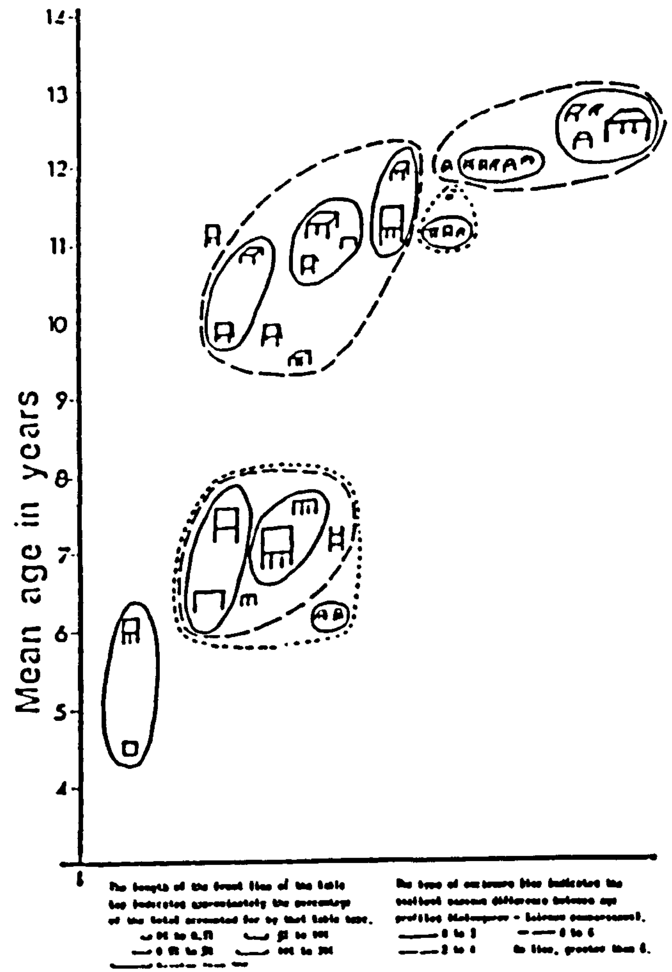


Figure 6:4. *Details of dendrogram for all tables drawn from observation.*

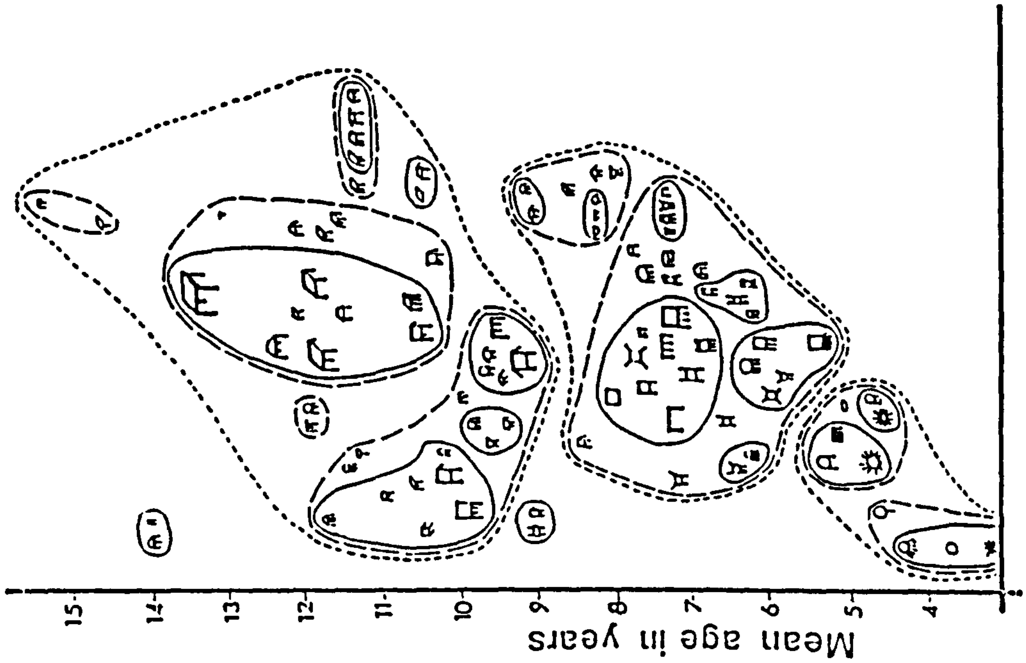


Figure 6:6. *Details of dendrogram for all tables drawn from imagination.*

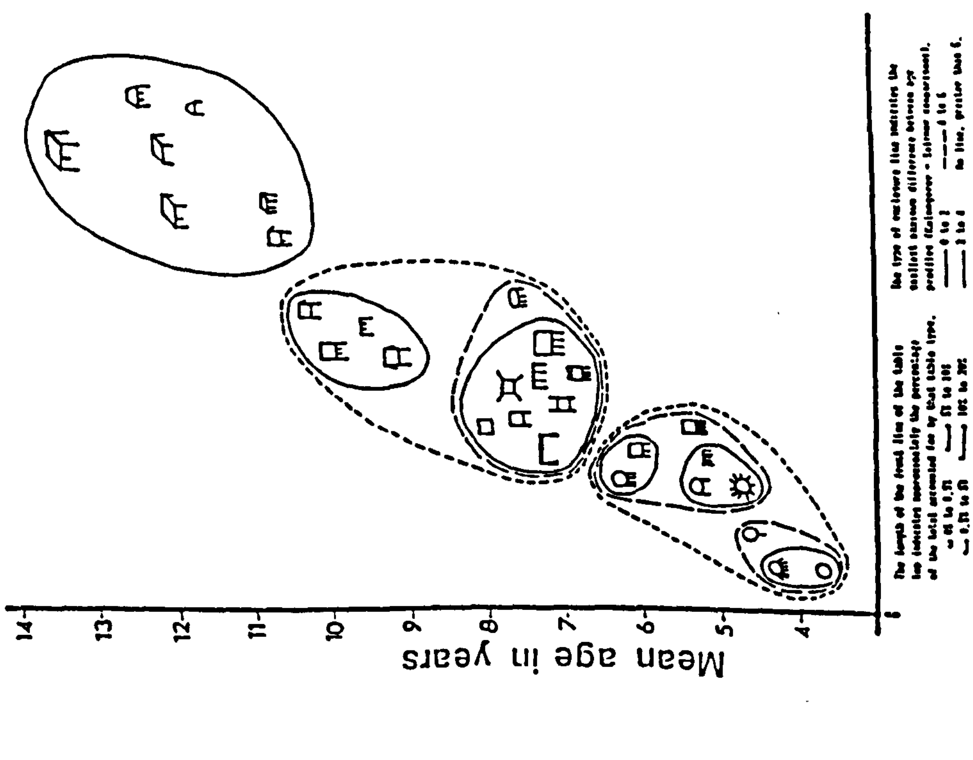


Figure 6:5. *Details of dendrogram for cells accounting for more than 0.5% of all tables drawn from imagination.*

for the imagination task. Figure 6:6 is formed from all the tables drawn from imagination. The inclusion of the cells that account for less than 0.5% of the data is sufficient to alter the form of the dendrogram such that some changes occur in the groupings of the cells with mean ages of about six years old and nine years old. It is possible that the table types represented by these cells are marginal, indicating a transition in development from one major group of depictions to another.

Development that is independent of task.

Minor task related differences have already been partially addressed and will be returned to later, but the present analysis is best served by an examination of common developmental trends. The great similarity between the dendrograms or the age profiles of each cell, whether drawn from observation or imagination, shows that this method of analysis does access such trends. The responses in some cells show task dependency, whilst the overall combinations of such responses do not. For this reason it was felt that an amalgamation of the two sets of data would strengthen the argument. Development, as shown by the dendrograms, would not be affected, whilst the task dependent aspects of the response would be lessened by such amalgamation. Therefore, the remainder of the chapter concentrates on analyses of the amalgamated data.

Figure 6:7 gives a reduced version of a Venn diagram of the amalgamated data, in which are represented table types accounting for greater than or equal to 0.5% of the total. Figure 6:8 gives the full version. The corresponding dendrograms and information upon which these are based can be found in Appendix 6:F.

Chapter 4 showed that the way in which table tops were depicted developed, independently of task, from orthogonal to non-orthogonal systems of natural perspective. Figures 6:7 and 6:8 show that this development is

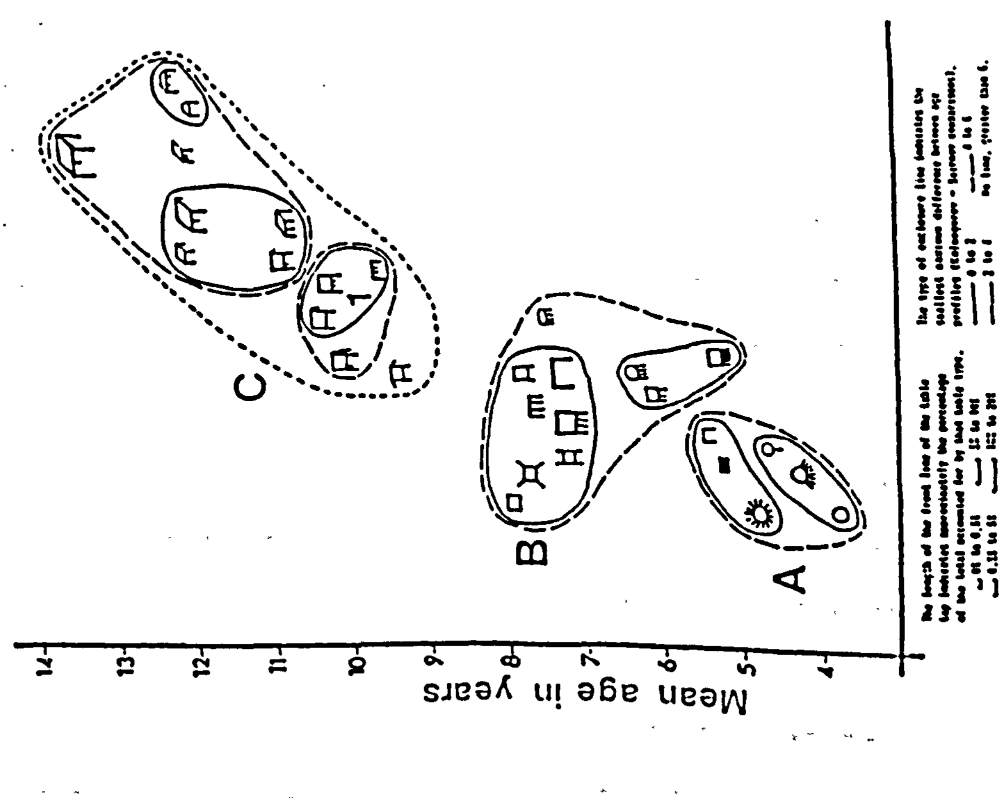


Figure 6:7. *Details of dendrogram for cells accounting for more than 0.5% of all tables drawn from observation and imagination.*

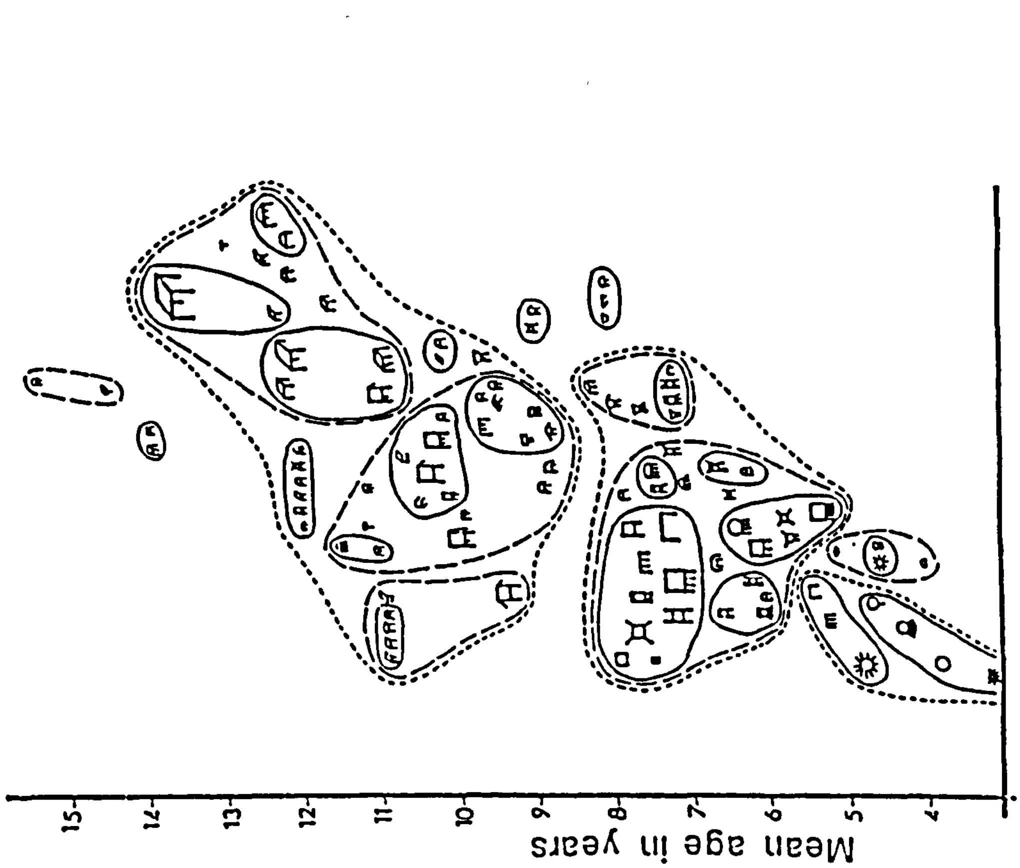


Figure 6:8. *Details of dendrogram for all tables drawn from observation and imagination.*

also apparent when the table drawings are classified independently of the way in which the table tops are drawn, the groups having been identified by age profiles derived from each individual cell of the classification table.

The ways in which the tables were drawn fall into three clear groups. The majority of the tables in the first group, the group containing the youngest children, could be classed as volumetric. The majority of the middle group could be classed as orthogonal, and the majority of the group containing the oldest subjects could be classed as non-orthogonal (Labelled A, B, and C, respectively in Figure 6:7). There appears to be no support for a theory suggesting development is directly related to the use of more complex projection systems, going through orthographic, vertical oblique, oblique, to perspective (as discussed in Chapter 3).

In each of the three major groups there appear to be sub-groups in which 'half-way' table types are represented. It is possible that these are links in the developmental chain. Although most closely associated with one particular group because of similarities in the age profiles, they contain features from both groups. Group C:1 is a clear illustration of this - here the table tops appear to be in orthogonal projection, yet the table legs are drawn in a non-orthogonal manner. This lack of consistency could indicate attempts to grasp a different form of depiction, and, as has already been suggested, the imagination data indicates a lack of clarity for some cells with mean ages of about six and nine years of age.

There is clear empirical evidence of developmental trends, but what is developing is unclear. Development does not appear to be linked to an increase in understanding of, or ability to produce, more complex projection systems. It does appear to be linked to a progression through volumetric, orthogonal, to non-orthogonal systems of natural perspective.

Such a descriptive account of what happens, however, takes us no nearer to the causes of this development.

C) DEVELOPMENT IN THE DEPICTION OF DEPTH.

In Chapter 1 it was suggested that there are four main types of theories that attempt to explain what the causes of development in the depiction of depth are. Theories involving stages in the understanding of space and theories involving visual realism both presuppose that view specific depiction is the end point of development. This has been shown in earlier chapters not to be the case, and so these theories will not be discussed further. The other two types of theory are related to conceptual/perceptual realism and production errors. Both assume that the child knows what he or she wishes to represent, and that the desired representation includes information about the spatial relationships between parts of the object and between the object and its surrounding space, but that the child is unable to represent this information accurately for some reason. Those theories relating to figural biases, particularly the role of symmetry, will only be discussed briefly here because they will be addressed more fully in Chapter 9.

Figural Biases.

These theories relate the subject's inability to represent the object as he or she wishes, to biases that are not seen as an integral part of spatial representation, but are seen to come into play whenever pen is set to paper. Two main figural biases that are relevant to table drawing are those towards symmetry and towards the use of right angles. In its pure form the assumption is that children understand depth cues but are prevented from using them because of these biases. For example, Mitchelmore (1985) suggests that children have available two primitives for analysing direction, namely parallels and perpendiculars. The young child's production is very largely based on the use of perpendiculars. Two possible reasons he gives for this are, firstly, the greater saliency of a proximal relation obtained when two lines meet over that of a distal relation when two lines are parallel. Secondly, he points out that the desire to create symmetry is an important force in a child's drawing (Bremner 1985b), and that perpendiculars imply a greater degree of symmetry than do parallel lines. He suggests that these effects diminish with age but are still discernible in older children and adults, and that it is not until middle or late childhood that parallels are used effectively.

Mitchelmore's suggestion that a reliance upon perpendiculars gradually develops into a reliance upon parallels ties in with the data presented in Chapter 4 in three important ways. Firstly, this is similar to development away from the use of orthogonal (orthographic/vertical-oblique) to the use of either affine (oblique) or projective (false perspective), depending upon the nature of the task. Secondly the development illustrated in these data occurs at the same age as that suggested by Mitchelmore. Finally, the gradual nature of the development found here is closely related to that suggested by Mitchelmore. Such a shift away from a reliance upon the use of right angles can be seen clearly here. Young children do use right angles, both when depicting table tops and table legs, whilst older children use more oblique angles. However, the data given here show more than this. The shift away from the use of right angles is not uniform. The subject may use right angles when drawing the table top, yet use oblique angles to depict the relationship between the top and the legs. Examples of this can be found in Group C in Figure 6:7, Cells 2i, 2h, 2e, and 2j. In these cases the subject appears capable of using oblique/acute angles, but for some reason does not wish to when representing the table top. The converse of this, in which oblique/acute angles are used for the top and right angles for the legs. is shown in Cell 3q and in Figure 6:8. These counter examples suggest that development in depiction is not entirely related to the ability to overcome these figural biases.

Depth Cues.

The other type of theory relates the inability to represent spatial information accurately to lack of understanding about how to use depth cues. The important depth cues under discussion here are those mentioned in Chapter 2. height in picture plane, occlusion, and diminishing size with distance. In its pure form the assumption is that once children understand the operation of depth cues they will use them, unhindered by figural biases. Reflection indicates that the child's ability to represent spatial relationships is probably partially described to a greater or lesser extent by a mixture of **both** types of theory.but this section of the chapter relates the data directly to the developing use of depth cues.

PROJECTION	DEPTH CUES			VIEW
	HEIGHT IN PICTURE	PARTIAL OCCLUSION	DIMINISHING SIZE	
ORTHOGRAPHIC	✗	✗	✗	
VERTICAL OBLIQUE	✓	✗	✗	
OBLIQUE	✓	✓	✗	
PERSPECTIVE	✓	✓	✓	

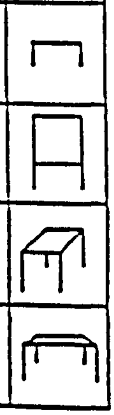


Figure 6:9. *The theoretical relationship between depth cues and projection systems.*

Theoretically the use of a particular projection system and the use of various depth cues co-vary and it is difficult to disentangle the two. Figure 6:9 illustrates the only combinations that would be considered correct if we were to assume that a subject was using a particular form of projection accurately. Even this simple analysis poses problems. Unseen hidden line elimination is consistent with the orthographic, vertical oblique and round forms of projection, although subjects who use these forms of depiction could also be using undetected occlusion. We can perhaps assume that this is not the case when subjects produce table top type 8, in which the top is drawn in vertical oblique projection, but objects on the table are depicted as if on the top edge, as if in orthographic projection.

The use of diminishing size with distance is also a grey area. Theoretically, a table drawn in linear perspective, whether drawn from centre front or from a corner, entails the use of diminishing size with distance. Empirically, as shown in Chapter 3, no subject used diminishing size with distance with internal consistency.

The argument that the use of projection systems and depth cues cannot be studied separately because of their co-variance is indeed valid if one assumes that drawings are internally consistent. Practically, as can be seen in Figure 6:2, subjects do not use a form of projection consistently. Most combinations of table tops and table legs are possible and many are produced. The possibility of a minor degree of co-variance is discussed later, but for the purposes of the present discussion the use of different depth cues is assumed to be independent of the use of projection systems.

Each Cell in Figure 6:2 contains a rating for height in picture plane (H), partial occlusion (O), and diminishing size with distance (D). These are based upon the way in which the table legs are drawn. The depth cue of height in picture plane was divided into four categories, namely:- no ground line (H1), plan view (H2), ground line (H3), and ground plane (H4). In the first category (H1) the table legs are drawn as radiating from the table top, with no apparent attempt made to depict the table's relationship to the ground. A subsection of this is the plan view (H2). In this type of drawing the table is shown as from above, with four legs, one extending from each corner. It is here that the classification system is at its weakest, because it is assumed that this form of drawing represents a coherent attempt to represent the table from above, and that the subject is not particularly concerned with showing the spatial relationship between the top of the table and the legs. This assumption is partially justified by comments that adults have made when drawing a table in this way, and by the lack of drawings done in this manner with a vertical oblique table top and with objects along the top edge. Indeed, any table with objects which was classified as showing a plan view depicted the objects also in plan view. However, this category contains an element of interpretation of the subject's intentions, and probably this is an incorrect interpretation in some cases.

Tables classed as having a ground line (H3) were drawn with the table legs descending to a common line, as if all legs, whether from the front or the back of the table, met the ground on a single line. When the table legs appeared to meet the ground on a plane, mirroring that of the table top, the drawing was classed as showing a ground plane (H4). Several types of table drawing cannot easily be categorised in this way. For example, 2q and 2y on Figure 6:2 show tables in which the legs are not drawn consistently. In such cases the drawing is classified according to the position of the majority of the table legs, or to the inferred use of height in picture plane. It is thus the figure in brackets that is the one used in this analysis (H4 and H2 respectively). Similarly, it is possible that in those tables in which only the front two legs are drawn (for example 1a or 2a in Figure 6:2) the child actually intended to represent a ground plane. Unfortunately, the child's intentions cannot be accounted for, and so the table must be classified as it appears, ie. with ground line only.

The depth cue of occlusion was divided into three categories, no occlusion (O1), lack of hidden line elimination (O2), or partial occlusion (O3). The drawing was placed in the third category if any part of it was partially occluded. If part of the table was totally occluded it could not be seen, and, as above, the table had to be classified as it appeared. It is, therefore, possible that the intention of some subjects was to depict total occlusion, and that this has not been accounted for. As above, the figure in the brackets indicates the classification used in this analysis.

Diminishing size with distance was identified as a depth cue earlier when a table was drawn in perspective. However, as discussed then, no subject used this depth cue when drawing the table legs, and no subject used oblique perspective on the table top in either study. Hence, although table tops were sometimes drawn in perspective, the system was never used for the whole table. It is thus not possible to ascertain the use of diminishing size with distance as a depth cue by examination of the way in which the table legs are drawn. For the purpose of this analysis data on the use of diminishing size with distance were derived from the use of perspective on the table tops and thus do not represent full use of the cue.

A full breakdown of percentage of total data, number of subjects, mean age and standard deviation for depth cue classification by form of projection can be found in Appendix 6:G, along with progressively amalgamated summaries of this information.

Figure 6:10 shows the development, with age, of the way in which depth cues are used. It can be seen that the use of ground line peaks at about six years of age, whilst the use of ground plane and partial occlusion rise steadily between six and twelve years of age. The use of no ground line incorporates that of plan view. It appears to drop rapidly between three and five years of age and then be used by about four percent of subjects until about nine years of age.

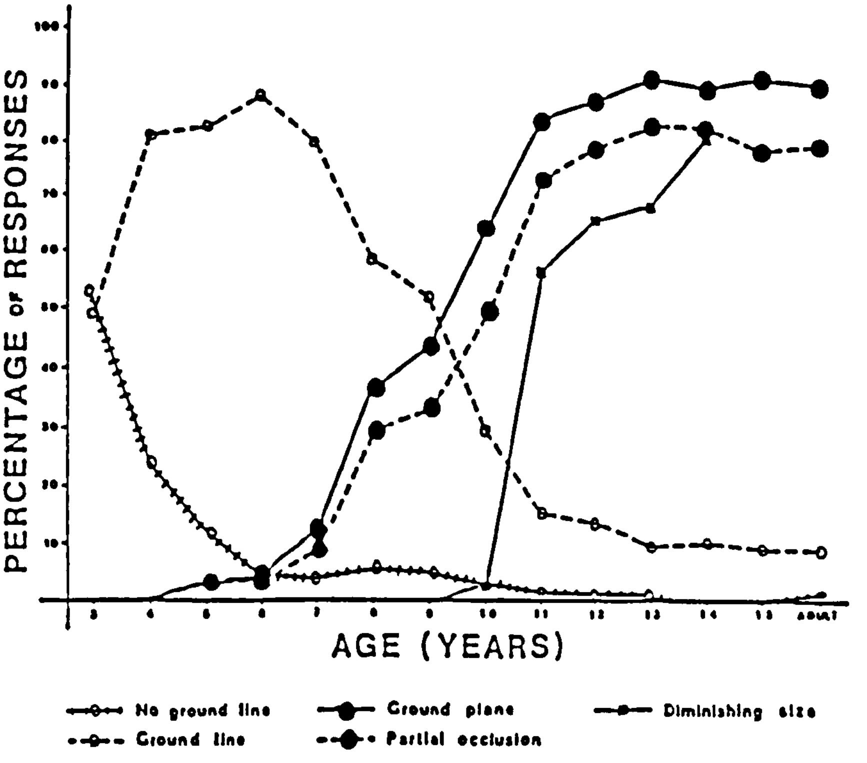


Figure 6:10. *Proportions, with age, of the use of depth cues.*

There are task related differences in the no ground line response. It only accounts for 0.61% of the observation data, yet accounts for 8.74% of the imagination data. Because of this it is difficult to compare its use across the two tasks. Figure 6:11 separates the response on the imagination task into the two groups of H1 and H2. They appear to present two different profiles with age. The first profile (given by Cells 5o, 6o, 9o, 5r, 6r, and 2v) accounts for 5.34% of the total imagination data and has a mean age of 3.4 years. It drops rapidly from 51% of the three year old responses to 1% at six years old. The second profile (given by Cells 2t, 2x, 5x and 2o) accounts for 2.12% of the total imagination data and has a mean age of 6.6 years. This has two separate peaks at four and eight years of age. It is suggested that the two profiles indicate different types of response. The first profile appears to show more of a volumetric response. Whilst this might also hold for the peak at four years of age in the second profile it is possible that the second peak in the second profile indicates that subjects intended to depict a plan view of a table, rather than a visually realistic view. This is supported by the observation, recorded earlier, that some adults reported deliberately responding in this manner.

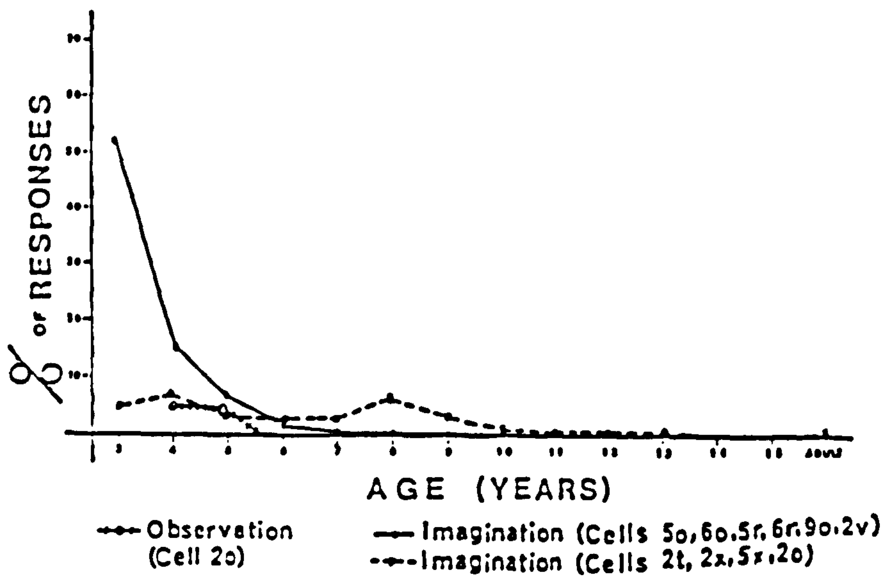


Figure 6:11 An analysis of the no ground line response.

Figure 6:11 emphasises the task related differences in the no ground line response. The subject sample of observation started at four years old and, because the majority of no ground line responses are made by the very young children, it might be expected that observation would elicit less of these responses than imagination. The responses that were elicited occurred in Cell 2o. In the imagination task this cell has a two peak profile. The second (plan view) peak is missing when a table is drawn from observation. It would be inappropriate to draw conclusions from this because of the very small numbers involved, but it would appear that drawing from observation restricted subjects sufficiently to prevent them producing plan views.

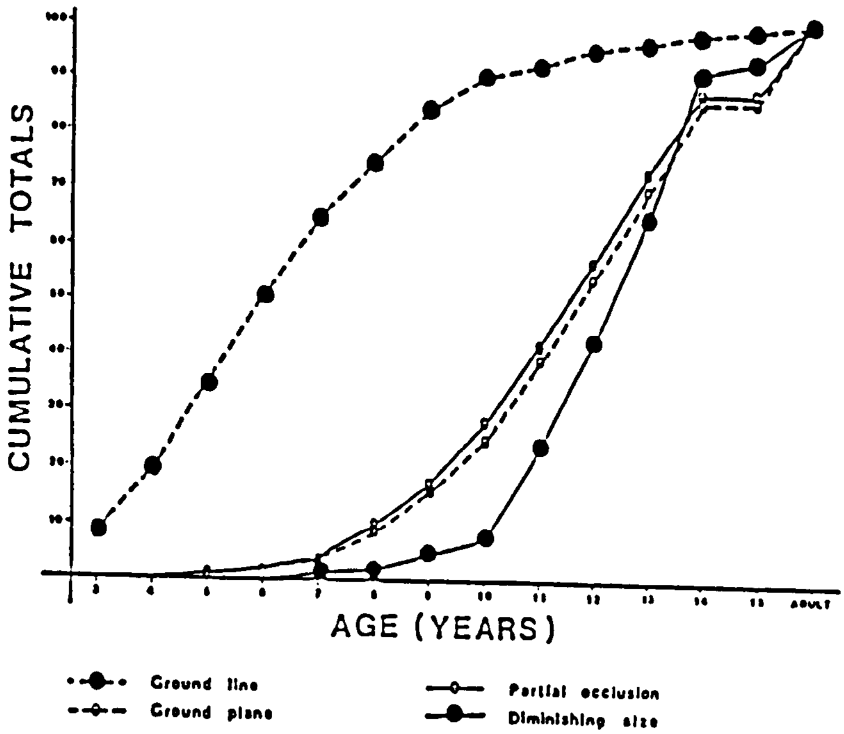


Figure 6.12. *Cumulative proportions, with age, of the use of depth cues.*

Chapter 4 showed that there is very little task related difference in the use of projection systems until about ten years of age. An examination of the way in which the table legs are drawn might give evidence for task related differences in the no ground line response. However, when the other depth cues are considered there does appear to be a strong overall similarity between the two studies (Ground line :- $\chi^2 = 16.4$, df = 10, $p > 0.05$; $r = 0.98$, $p < 0.001$. Ground plane :- $\chi^2 = 12.7$, df = 9, $p > 0.1$; $r = 0.96$, $p < 0.001$. Partial occlusion :- $\chi^2 = 6.4$, df = 9, $p > 0.5$; $r = 0.98$, $p < 0.001$). Diminishing size with distance cannot legitimately be compared for the reasons given earlier.

Figure 6.12 illustrates the cumulative totals of the depth cues under discussion. It can be seen that by six years of age 50% of the subject population use ground line and by about twelve years of age 50% use a ground plane, partial occlusion and 'false' diminishing size with distance. The development of ground plane and partial occlusion are very highly correlated ($\chi^2 = 0.26$, df = 11, $p > 0.99$; $r = 1$, $p < 0.001$) yet, as can be seen in Figure 6.13, if a subject only uses one of these depth cues they are more likely to use ground plane than partial occlusion. 6.72% of all responses involved ground plane with no partial occlusion, whereas the reverse only accounted for 0.85% of all responses. That is, in these studies, ground plane appears to be used alone more frequently than does partial occlusion. It is possible that this is because the use of ground plane develops marginally before the use of partial occlusion.

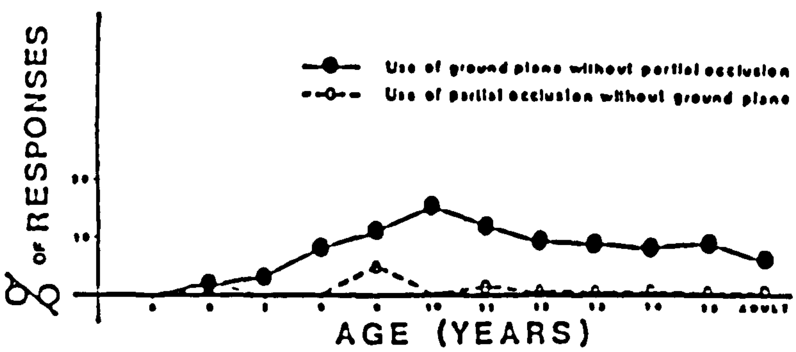


Figure 6.13: *The relationship between the use of either partial occlusion or ground plane.*

D) THE RELATIONSHIP BETWEEN PROJECTION SYSTEMS AND DEPTH CUES.

In Chapter 4 common developmental trends were identified between the drawing of a table from observation or from imagination. The drawing of table tops appeared to progress from the system of orthogonal natural perspective (orthographic and vertical oblique projection) to those of affine and projective systems of natural perspective (oblique and perspective). What was actually developing was unclear, but it was suggested that development might be related to a shift away from the use of right angles. Consideration of the way in which the table legs are drawn suggests that this is not the whole story. Figure 6:14 indicates that this shift in use of form of projection is very similar to the changing use of particular depth cues. Lack of ground plane correlates

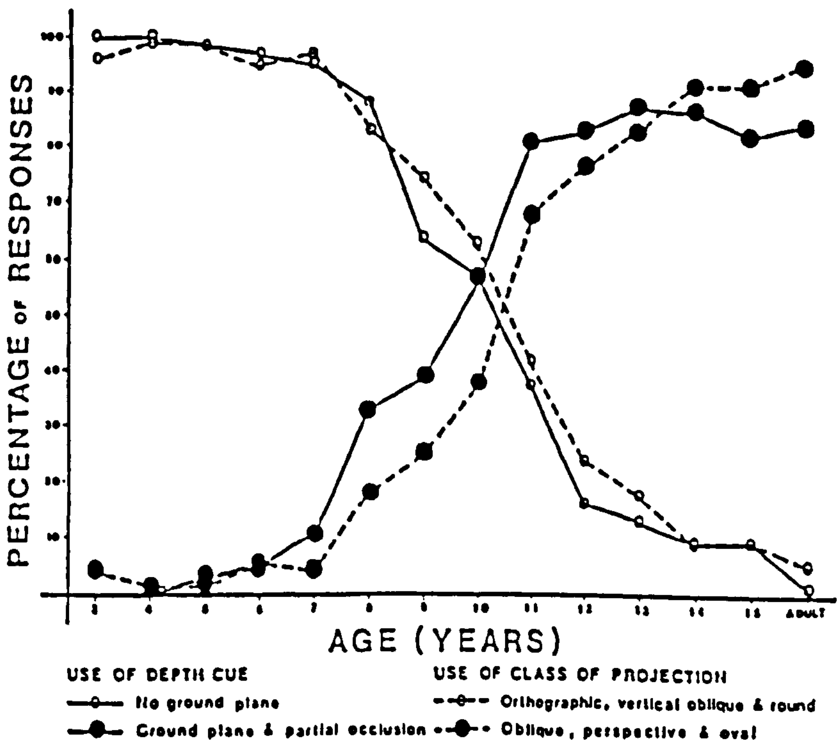


Figure 6:14 *The relationship between the use of depth cues and projection systems.*

highly with the use of round, orthographic, and vertical oblique table tops ($r = 0.99$, $p < 0.001$), and the use of ground plane and occlusion correlates highly with oval, oblique, and perspective table tops (ground plane:- $r = 0.98$, $p < 0.001$; partial occlusion:- $r = 0.98$, $p < 0.001$). This demonstrates a strong relationship between the use of depth cues and the class of projection used. Superficially this relationship could be seen as a by-product of experimental design, in which a 'higher' depth cue cannot be produced until a 'higher' class of projection is also used. Empirically, this does not appear to be the case. Figure 6:15 illustrates that where there is a mismatch between the complexity of the depth cues used and the class of projection it was almost universally the case that the depth cues used were more complex than the projection system. From this it can be seen that depth cues may lead to the use of projection systems, but not the reverse.

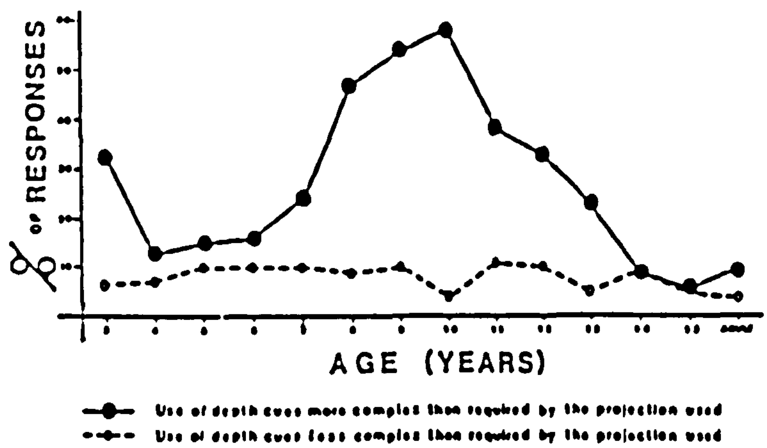


Figure 6.15 A comparison of the degree of complexity involved in the use of either depth cues or projection systems

The tasks given here do limit the use of particular depth cues in particular instances. For example, there appears to be little incentive to use diminishing size with distance when drawing from imagination, or to use no ground line with a plan view when drawing a table from observation. Both these examples were only produced by a few subjects. Given these limitations, it is suggested that when the use of depth cues is analysed on two similar tasks development in the production of each depth cue appears to be independent of task constraints. Further, development in the use of depth cues appears to occur before development in the use of more complex projection systems.

The general validity of these findings would be enhanced if they were found to be applicable to less similar tasks. In Willats (1977a) measured the use of partial occlusion by counting the number of overlaps used when objects were drawn upon a table top. The developing use of partial occlusion was thus ascertained in a way dissimilar to that used here. When the frequency with age profile for partial occlusion obtained by Willats is compared with that given here a χ^2 test fails to find any significant differences between them ($\chi^2 = 12.08$, df = 8, $p > 0.1$; $r = 0.91$, $p < 0.001$). Cox (1981) measured the developing use of partial occlusion by asking children to draw two objects, one behind the other. Although her subjects demonstrated the use of partial occlusion at an earlier age than that reported here there is still a significant correlation between the frequency with age profile that she obtained and that given here ($r = 0.91$, $p < 0.01$). To conclude, these comparisons show that there is a common underlying development in the use of partial occlusion, as measured between objects as well as within an object. An interesting line of further research would be to investigate whether there is a similar commonality in the use of height in the picture plane.

E) CONCLUSIONS.

In this chapter it has been shown that there is clear development in the use of depth cues. Further, it has been shown that the use of depth cues is much less task dependent than the use of a particular projection system. It has been suggested that this development is independent of the use of projection systems and precedes it. This implies that a child does not normally use a particular projection system until it understands the necessary depth cues.

These findings are relevent to the teaching of projection systems, and perspective in particular. It is possible that subjects could be taught to use a more complex form of projection without understanding it. For example, children can be taught to draw a particular object in perspective by rote, but although the basic theory behind linear perspective is simple it is notoriously difficult to teach to young children, and they find it difficult to transfer this knowledge to the drawing of other objects or scenes. These findings suggest that those children who fail to grasp the principles of more complex forms of projection might lack an understanding of the underlying depth cues. This indicates that training should be aimed, initially, at the use of depth cues rather than the more formal use of projection systems. This would appear to be a fertile area for further investigation.

CONTENTS OF CHAPTER 7.

Preference in representation of tables.

Chapter 7.

Preference for different types of depiction.

Summary.

It has been shown that even adults frequently do not draw a table in perspective, and that the majority use visually unrealistic oblique projection when given a task with few constraints. Development in the depiction of a table appears to be closely related to development in the use of depth cues. It is unclear whether children draw in the way that they do because they are constrained by an inability to use more complex depth cues, or because they actually prefer tables drawn in this way.

This chapter examines the form of depiction that subjects prefer. The first study looks at the preferences shown by a full cross section of subjects and the effect that the way in which the question is worded has upon this. It is found that the majority of subjects, of all ages, prefer a table in some form of oblique projection, and that the wording of the question has a small effect upon the responses made by younger children. The preference shown by some younger children for tables depicted in a less complex manner is discussed.

The following two studies examine the preferred form of depiction when depth cues within the drawing are accentuated. The final study looks at the preferred form of representation of a given table, placed in front of a subject. It is found that some form of oblique projection is preferred in all cases, even when visual realism is highlighted. The preferred form of oblique projection is discussed in relation to the idea of a canonical table.

Introduction.

Linear perspective is a projection system that closely approximates to how we see objects and is easy to use once the rules are grasped. Some researchers have argued, to a greater or lesser extent, that this is the form of projection used by adults, and that children would also use it if they were 'mature' enough. This view holds many assumptions that merit closer examination. The first, that linear perspective is the form of projection commonly used by adults, is belied by empirical evidence. The previous chapters have shown that the use of linear perspective by adults is task dependent.

It could be argued that adults would actually prefer to draw in linear perspective, but are constrained from doing so for some reason. However, Hagen and Elliot (1976) presented adults and children with a computer generated range of line drawings of regular solids, illustrated in Chapter 1, Figure 1:3. The stimuli differed in the degree of convergence shown, and it was found that objects portrayed in oblique projection were preferred to those drawn in linear perspective. Hagen and Jones (1978) repeated this experiment, and found that four year old children performed at chance level. They suggested that this might be caused by the difficulty young children have in interpreting pictorial depth.

The Hagen and Elliot (1976) study is repeated here, in a highly modified form applicable to drawings of tables, in order to clarify whether the strong preference for oblique projection shown by older children and adults holds in the present experimental conditions.

Any discussion relating the form of depiction preferred by a subject to the way in which that person draws immediately becomes entangled in the assumption that subjects would prefer to produce that form of depiction when drawing. The relationship between a subject's preference and their actual production is discussed more fully in the following chapters. For the purposes of the present discussion it will be assumed that preference does indicate a desire to produce that particular form.

The second question addressed in this section is whether the wording of the question does indeed affect the answer, and if so, how. This is because it is not very clear what is meant by 'preference'. Subjects may well think that the depiction of a table looks most artistic in one form, carrying with it personal value judgements about what 'artistic' is, but that another form of depiction is a much better representation of the table's 'tableness' Hence the way in which subjects interpret the question of which table they 'prefer' may well affect the answer. If so, this has implications for the assumption that the subject's preferred form of depiction is unchanging.

Finally, the last topic addressed in this section is whether or not the subject's preference develops with age, and if so, how. This has implications for two, differing, assumptions that are sometimes made about children's drawings. The first is that all subjects would prefer to draw in the same way that adults do, but that something is preventing them. This implies that the thrust of developmental research is to find out what that 'something' is. The second is more 'stage-like'. It suggests that the child's preferred form of depiction changes with age, and that the child is happy with the accuracy of his or her depiction. This implies that the thrust of developmental research is to find out why the child's preferred form of depiction changes with age. There is support for both positions, and they are not necessarily mutually exclusive.

Freeman (1980b), Golomb (1973), Kosslyn *et al* (1977), and Lewis (1963) all found that preference was in advance of production for young children, and Hart and Goldin-Meadow (1984) found that children of all ages preferred the most advanced drawing. Taylor and Bacharach (1981) obtained a combination of results. They found that scribblers and mature drawers chose a complete figure of a man, whilst children who drew a tadpole figure preferred a drawing similar to their own. However, Moore (1986a) criticised these studies on several grounds, in particular; a) whether the drawings used for ascertaining preference were similar in style to the children's own (Golomb 1973, Kosslyn *et al* 1977, and Lewis 1963); b) extent of choice allowed (Taylor and Bacharach 1981, Hart and Goldin-Meadow 1984); c) confounded variables in complexity of stimuli (Hart and Goldin-Meadow 1984); d) failure to vary the order of presentation of stimuli (Lewis 1963); and e) use of between subject designs (Freeman 1980b). Moore's study was designed to overcome these problems and she found that children do prefer drawings of houses that have the most in common with their own drawings. Brooks *et al* (1988) extended these findings to cover both younger children and the drawings of people, and obtained the similar results.

It is interesting to note that both Brooks *et al* and Moore asked their subjects to choose the best picture, whilst both Kosslyn *et al* and Taylor and Bacharach asked the majority of their younger subjects to choose the picture that looked most like the object.

In each of the following studies subjects are presented with a range of line drawings and asked to choose one. The studies vary in the types of line drawing and the conditions under which they are presented. The first study examines preference for type of table drawing, with age, for both forms of question (most like and best picture). This study controls for the problem areas highlighted by Moore, except for the fifth which is addressed in the next chapter. In the second study the degree of shading is varied, in the third the background is altered, and in the final study subjects are asked for their preference of line drawing whilst comparing the stimuli with a real table.

STUDY 7: 1

Preference for table type, with age, related to form of question.

Method.

Subjects. 832 subjects were used, ranging from 1 year 6 months old to middle age. All were experimentally naive. The subjects were all from Chorley, Lancashire, a small semi-industrial town. The majority were taken from primary and secondary schools. Those too young or old to be approached in this way were seen in toddler groups or in their homes. These subjects are less free from bias, although attempts were made to approach a cross section of the community.

Stimulus. The set of stimuli consisted of an array of sixteen line drawings of a table, an example of which can be seen in Figure 7:1. The numbers which enable identification of the line drawings in this figure were not shown on the actual stimuli. Two forms of the stimuli were used in order to control for response bias. The majority of the line drawings in the stimuli are those that have been shown to be most frequently drawn when a table is depicted from observation or imagination. A variety of combinations of table top and table leg were used to enable the choice of form of projection on the table top or implicit depth cue in the table legs to be assessed independently.

A discrepancy here is the omission of a table in orthographic projection. The reasons for this are twofold. Firstly, studies reported in earlier chapters showed that there was little difference between the use of orthographic and the use of vertical oblique projection. Similarly, a pilot study showed that there was little difference between these two forms of projection in proportions of preference, with age.

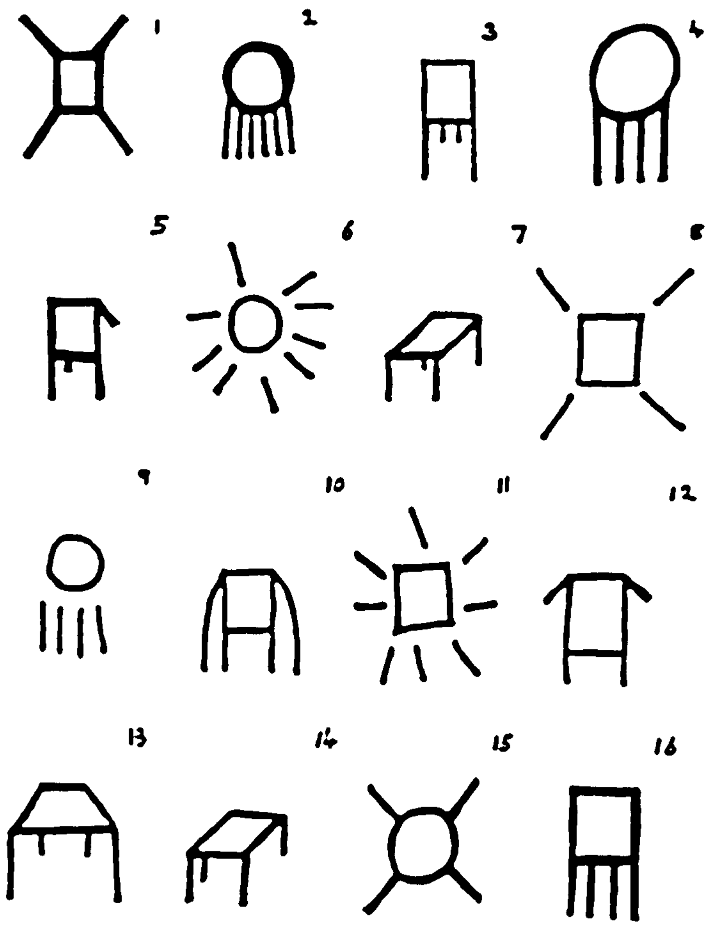


Figure 7·1. *An example of the stimuli used in Study 7:1.*

Secondly, one of the areas of investigation in this study was proportions of preference, with age, of depth cues implicit in the way the table legs are drawn. To do this it was necessary to have roughly similar numbers of examples of each depth cue contained within the line drawing. Line drawings in orthographic projection cause particular problems here, because the depiction by the legs of height in picture plane or partial occlusion is contradicted by the lack of these cues in the table top. It was also felt that a choice of more than sixteen line drawings, which would have been necessary if orthographic projection was included, would be too taxing for the younger children. It was appreciated that this might cause problems in the interpretation of the response on line drawings in vertical oblique projection, and this will be discussed later. However, it was felt that this would be outweighed by benefits gained by having more complete data on the choice of depth cue.

A pilot study was necessary because neither Study 3 nor Study 4 included subjects as young as those used here. It indicated that forms of line drawing numbered 6, 8, 9, and 11 in Figure 7:1 (table tops with separate legs) were similar in content, even if a lot neater than, the types of 'directed scribble' produced by such young children when asked to draw a table.

Procedure. The subjects were divided into two groups, balanced across sex and ability, designated B.P. (best picture) or M.L. (most like). Each subject was seen individually and was shown one of the two stimuli. Order of presentation of the two stimuli was balanced across sex and ability. The subject was told "These are all tables that people have drawn", and was then asked either "Which do you think is the best picture of a table?" (B.P. group) or "Which do you think is most like a table?" (M.L. group). Age, sex, group, form of stimulus, and choice of line drawing were then recorded. Many of the youngest subjects did not respond immediately. If this were the case the question was repeated twice more. Most of the very young subjects had responded by this time as had all those three years of age and older. Those that did not were excluded from the sample and alternative subjects were chosen. This exclusion policy may possibly have created bias in the sample towards the more able one and two year olds. Subjects were also excluded if they chose immediately, without looking at all the line drawings. This introduces a potential for subjectivity into the study. It was, however, immediately obvious when subjects were making such snap decisions, and so there was in practice a clear division between the excluded group and the included group. The number of subjects excluded for this reason was very small.

Results.

The data obtained in this study are given in Appendix 7:A.

The line drawings can be grouped according to the form of projection used on the table top, or according to the depth cues implicit in the way in which the table legs are drawn. The rationale behind this form of classification is presented in the previous chapter. The line drawings are not evenly distributed over these systems. There are 5 with a round table top, 8 in vertical oblique, 2 in oblique, 1 in perspective, 4 with legs separated from the table top, 2 showing no ground line, 4 with a ground line, 6 with a ground plane, 7 showing no occlusion and 5 showing partial occlusion. If subjects chose a line drawing at random they would be expected to reflect these ratios in their preferences. This ratio, or anything similar, was not evident at any age, either for table tops or depth cues. Therefore it was assumed that the majority of all subjects, including the youngest ones, were indeed trying to answer the question accurately.

Figures 7:2 and 7:3 show the proportions, with age, of type of table top and type of depth cue in the legs, respectively, when subjects were asked to choose the line drawing that looked most like a table. It can be seen that, with this form of question, the majority of subjects at all ages preferred the table top in oblique projection. Similarly, the majority of subjects at all ages preferred table legs showing a ground plane and partial occlusion. One tailed Kolmogorov Smirnov χ^2 approximation for two independent sample tests [*which will be termed $K\chi^2$ from henceforth*] failed to find any significant differences in the proportions of responses, with age, for these categories (oblique vs.

partial occlusion, $K\chi^2 = 0.25$, $df = 2$, $p > 0.05$; oblique vs. ground plane, $K\chi^2 = 0.99$, $df = 2$, $p > 0.05$; partial occlusion vs. ground plane, $K\chi^2 = 0.25$, $df = 2$, $p > 0.05$).

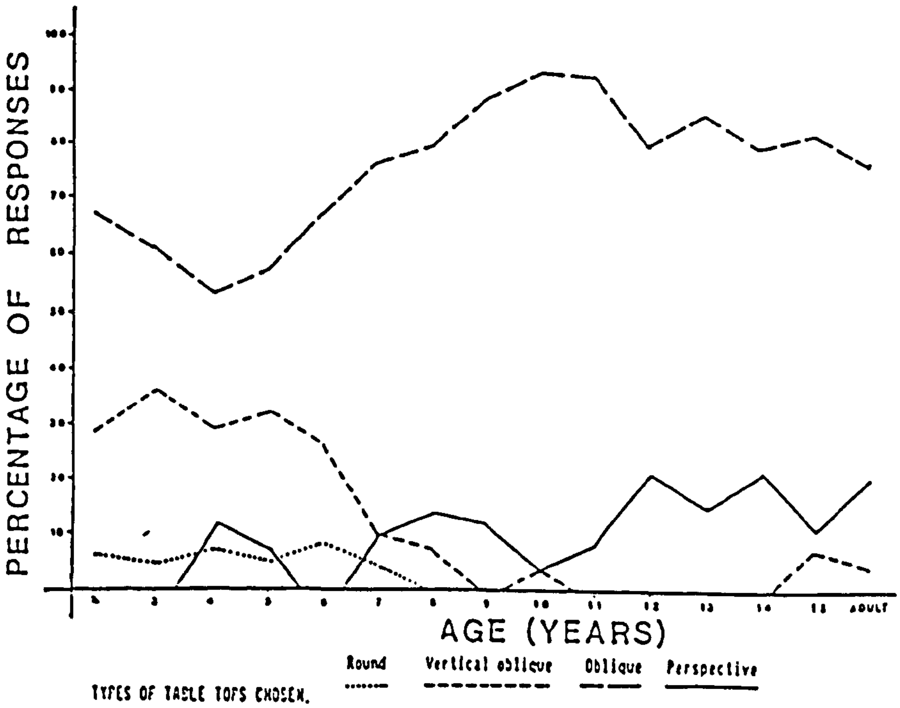


Figure 7:2. The proportions of preference, with age, for different table tops under the M.L. condition.

The preference for a ground plane and partial occlusion is very clear. Very few children prefer a table with no ground line, although 10 to 20 percent of children between 2 and 6 years old think that the line drawing which is most like a table is one in which the table top has the legs separate and there is a ground line or no partial occlusion. $K\chi^2$ tests failed to find any significant differences between these in proportions of responses, with age, (top only vs. no partial occlusion, $K\chi^2 = 4.77$, $df = 2$, $p > 0.05$; top only vs. ground line, $K\chi^2 = 0.59$, $df = 2$, $p > 0.05$; ground line vs. no partial occlusion, $K\chi^2 = 3.58$, $df = 2$, $p > 0.05$). Similarly, whilst the majority of children at all ages preferred a table top in oblique projection this response was not unanimous. A substantial number of the younger children thought that a table top in vertical oblique projection looked most like a table, and up to 20% of the older subjects at any one age preferred perspective.

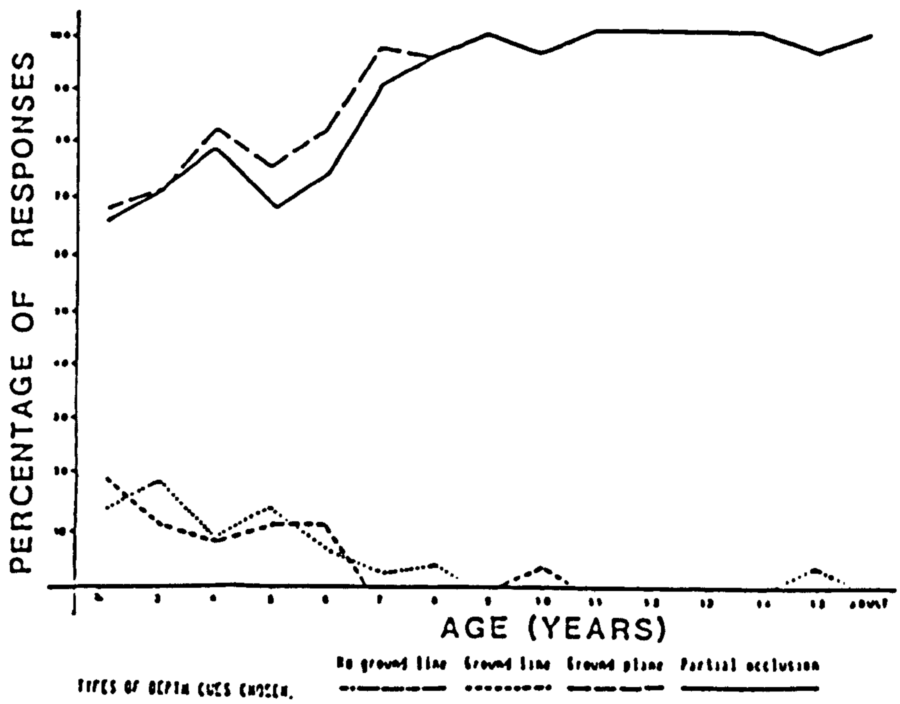


Figure 7:3. The proportions of preference, with age, for different depth cues under the M.L. condition.

Very few subjects thought that a round table top looked most like a table. $K\chi^2$ tests failed to find any significant differences in proportions of responses, with age, between a round table top or one in vertical oblique projection ($K\chi^2 = 1.43$, df = 2, $p > 0.05$) even though the number of subjects choosing each one differed. $K\chi^2$ tests did, however, show a significant difference in proportions of responses, with age, for a table top in oblique projection as opposed to one in perspective ($K\chi^2 = 26.3$, df = 2, $p < 0.001$).

Figures 7:4 and 7:5 show the proportions, with age, of type of table top and types of depth cues in the legs, respectively, when subjects were asked to choose the line drawing that was the best picture of a table. Under this condition the response is more varied. By eight years old the majority of children prefer a line drawing in oblique projection, with ground plane and partial occlusion. Kχ^2 tests failed to find any significant differences in proportions of response, with age, for these conditions (oblique vs. partial occlusion, Kχ^2 = 0.25, df = 2, $p > 0.05$; oblique vs. ground plane, Kχ^2 = 0.99, df = 2, $p > 0.05$; partial occlusion vs. ground plane, Kχ^2 = 0.92, df = 2, $p > 0.05$). However, young children

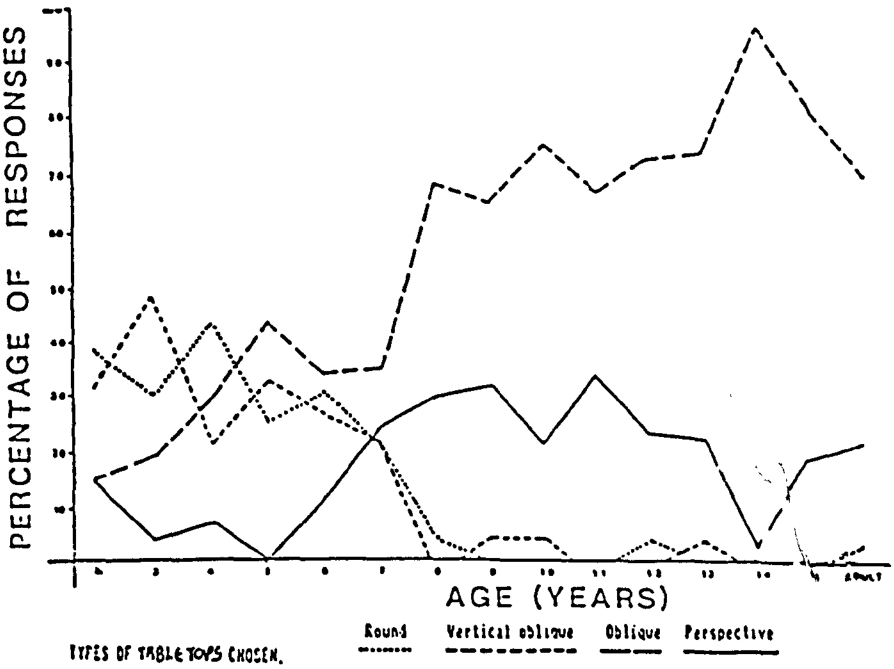


Figure 7:3. *The proportions of preference, with age, for different table tops under the B.P. condition.*

also show a strong preference for a table top in either round or vertical oblique projection, a table top separated from the legs, lack of partial occlusion, and lack of ground line. Kχ^2 tests fail to show significant differences between the proportions, with age, for either vertical oblique vs. round table tops (Kχ^2 = 1.39, df = 2, $p > 0.05$) or no partial occlusion vs. tops separated from the table legs (Kχ^2 = 3.51, df = 2, $p > 0.05$). Significant differences were found, however, between oblique projection vs.

perspective ($K\chi^2 = 13.7$, df = 2, $p < 0.05$), no partial occlusion vs. no ground line ($K\chi^2 = 6.25$, df = 2, $p < 0.05$) and no ground line vs. tops separated from legs ($K\chi^2 = 7.9$, df = 2, $p < 0.05$).

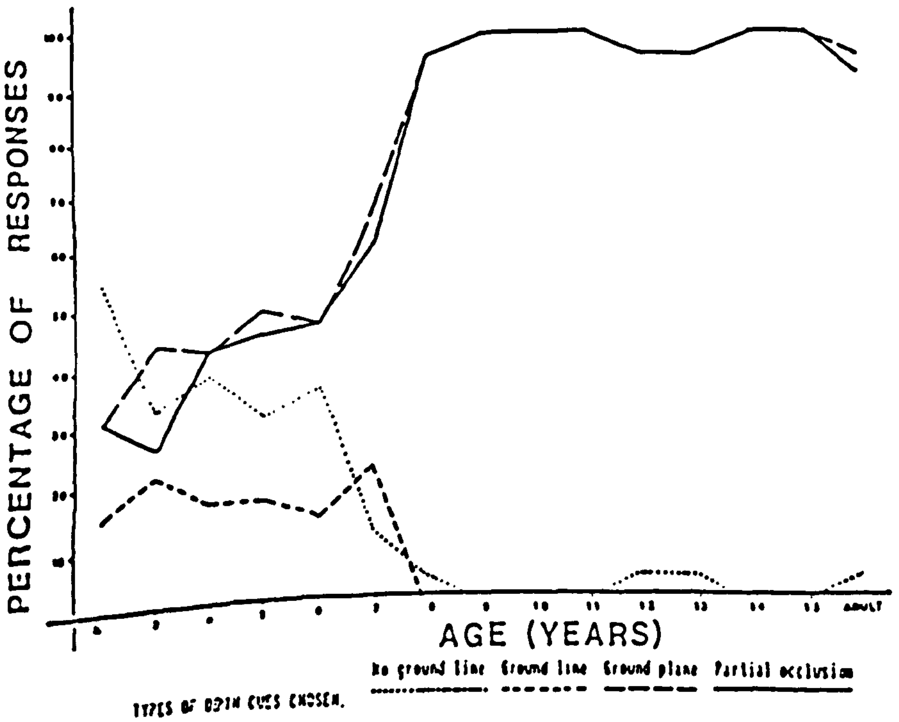


Figure 7.5. The proportions of preference, with age, for different depth cues under the B.P. condition

The one really clear finding is that under both conditions older children and adults strongly prefer a table that is represented in oblique projection, and/or shows the use of ground plane and partial occlusion. The stimulus did not allow subjects to choose a table top in oblique projection without also choosing the other two, but very few subjects chose either ground plane or partial occlusion without also choosing a table top in oblique projection. This can be illustrated by examining the number of such responses as a percentage of total responses for that particular question. In the Best Picture condition these were only 0.15%, and 0.14% respectively, and in the Most Like condition they were 0.22% and 0.2% respectively.

Form of Question.

The second area of investigation in this study is whether the form of question affects the response. It is obvious that it does so in the expressed preference for a table top in oblique projection. The majority of children of all ages preferred a table top in oblique projection, and table legs showing ground plane and partial occlusion, when asked which picture they thought was most like a table. However, the younger children, when asked which was the best picture of a table, did not prefer these factors and the response, as noted above, was much more varied. When proportions of response (form of projection and type of depth cue), with age, are compared between the two conditions significant differences are found in the choice of oblique table top ($K\chi^2 = 37.96$, $df = 2$, $p < 0.001$), ground plane ($K\chi^2 = 30.48$, $df = 2$, $p < 0.001$), partial occlusion ($K\chi^2 = 29.81$, $df = 2$, $p < 0.001$), table tops in perspective ($K\chi^2 = 20.69$, $df = 2$, $p < 0.001$), and no ground line ($K\chi^2 = 6.85$, $df = 2$, $p < 0.05$). The same test failed to find significant differences between the two conditions for a table top in vertical oblique projection ($K\chi^2 = 1.35$, $df = 2$, $p > 0.05$), a round table top ($K\chi^2 = 0.36$, $df = 2$, $p > 0.05$), table tops separate from the legs ($K\chi^2 = 4.24$, $df = 2$, $p > 0.05$), ground line ($K\chi^2 = 4.17$, $df = 2$, $p > 0.05$), and no partial occlusion ($K\chi^2 = 3.99$, $df = 2$, $p > 0.05$).

The above findings lead to a complex picture and need further discussion before they can be interpreted. As can be seen in Figures 7:2 to 7:5, in all cases, excepting that of perspective, differences between the two tasks are restricted to subjects aged between two and seven years old. In general, across all ages, there is a greater perspective response when subjects are asked to choose the best picture, although the difference between the total percentage of response in each condition is only 0.8%. This will be discussed later. More important for the present argument is the observation that from seven years up, $K\chi^2$ tests fail to find any significant differences between the two tasks in proportions, with age, of oblique ($K\chi^2$ = 4.59, df = 2, p > 0.05), ground line ($K\chi^2$ = 4.77, df = 2, p > 0.05); ground plane ($K\chi^2$ = 1.75, df = 2, p > 0.05), or partial occlusion ($K\chi^2$ = 0.77, df = 2, p > 0.05). This implies that the vast majority of the main effect is confined to the 2 to 7 age groups.

Both tasks elicit the same types of response from 2 to 7 year olds. The quality is therefore the same across tasks, although the quantity differs. The numbers of young subjects preferring a picture with the top separate from the legs, with a round top, with a top in vertical oblique projection, with no ground line, with a ground line, or with no partial occlusion are much greater when children are asked which they think is the best picture. All these are aspects of pictures drawn by children of these ages. The only exception to this is the no ground line response, but this response is closely mirrored by that for line drawings with the tops separate from the legs. It can be argued that it is false to separate the two, indeed, when the two are amalgamated $K\chi^2$ tests fail to find any significant differences between the two tasks in proportions of response, with age ($K\chi^2$ = 0.52, df = 2, p > 0.05). The difference between the two tasks in quantity rather than quality is interesting, and will be referred to later when developmental trends in the data are examined. For the moment it is worth noting that young children choose more non-visually realistic line drawings when asked which they think is the best picture of a table.

An interesting aspect of these data is the comparative responses made to line drawings 7 and 14 (classed as 3h and 3j respectively). These two drawings both have the table tops in oblique projection, but the inside back leg is longer in drawing 14. Figure 7:6 shows the responses for these two line drawings across both conditions. In this figure the proportion of responses obtained on 3j, at each age, is presented as a percentage of the total preference for an oblique table top shown by that age group.

Figure 7:6. The proportions of 3j responses as a percentage of the oblique response for each age group, for M.L. and B.P. conditions.

There are significant differences between responses on all four conditions (3h BP vs. 3h ML, $K\chi^2 = 8.12$, df = 2, $p < 0.05$; 3j BP vs. 3j ML, $K\chi^2 = 56.21$, df = 2, $p < 0.001$; 3h BP vs. 3j BP, $K\chi^2 = 33.66$, df = 2, $p < 0.001$; 3h ML vs. 3j ML, $K\chi^2 = 207.81$, df = 2, $p < 0.001$). There is a general increase in proportions of response, with age, on line drawing 7 (3h), with more subjects preferring it under the ML task. The response on line drawing 14 (3j) is, however, more complex. It can be seen that subjects between 5 and 10 years of age prefer it to the more accurate 3h response, however older subjects increasingly prefer table type 3h. This effect is accentuated when subjects are asked to choose the line drawing that is most like a table. Subjects frequently took some time to decide between the two, and some reported that line drawing 14 (3j) 'felt' better, but they appreciated that line drawing 7 (3h) was a more accurate representation, therefore they chose that one.

In conclusion it would appear that the form of question significantly affects the response. Younger subjects choose more non-visually realistic table types when asked which they think is the best picture of a table, and whilst this effect is less obvious in the older subjects, it is still apparent.

Development in Preference.

The last section addressed in this analysis is whether the subjects preference changes with age, and if so how. The relationship between preference and production is examined directly in the next chapter where each subject is assessed on a variety of tasks. The problem with that design is that subjects are no longer experimentally naive. Here the data are examined for developmental trends, and are related to the amalgamated data presented in the preceding chapter, obtained when subjects drew a table from observation or imagination.

Figures 7:7 and 7:8 show the cumulative proportions of response, with age, obtained under the three tasks (Most Like question, Best Picture question, and amalgamated data from tables drawn from observation and imagination). These are complex figures. A cumulative analysis is used to give a picture of the general trends. For the same reason it is necessary to include information for each task in one figure. It is suggested that these figures are used as a reference, rather than a complex illustration. Figure 7:7 shows the responses classified according to the type of table top, namely, round, vertical oblique, oblique, and perspective. The other types of top obtained when a table was drawn from observation or imagination are not included in this analysis. Figure 7:8 shows the responses classified according to the use of depth cues in the table legs.

In the previous chapter the use of depth cue was shown to be hierarchical, and so to clarify the figure only the cumulative totals for ground line, ground plane and partial occlusion are given. In both figures the diagonal line, marked AB, indicates the profile that would be obtained if a positive response were obtained from an equal proportion of subjects in each age group.

The close similarity seen in Figure 7:7 between the cumulative totals for round and vertical oblique table tops with Most Like and Best Picture questions reflects the failure to find significant differences between them. Nearly all responses for these conditions occur before 7 years old. The corresponding profiles for the oblique and perspective

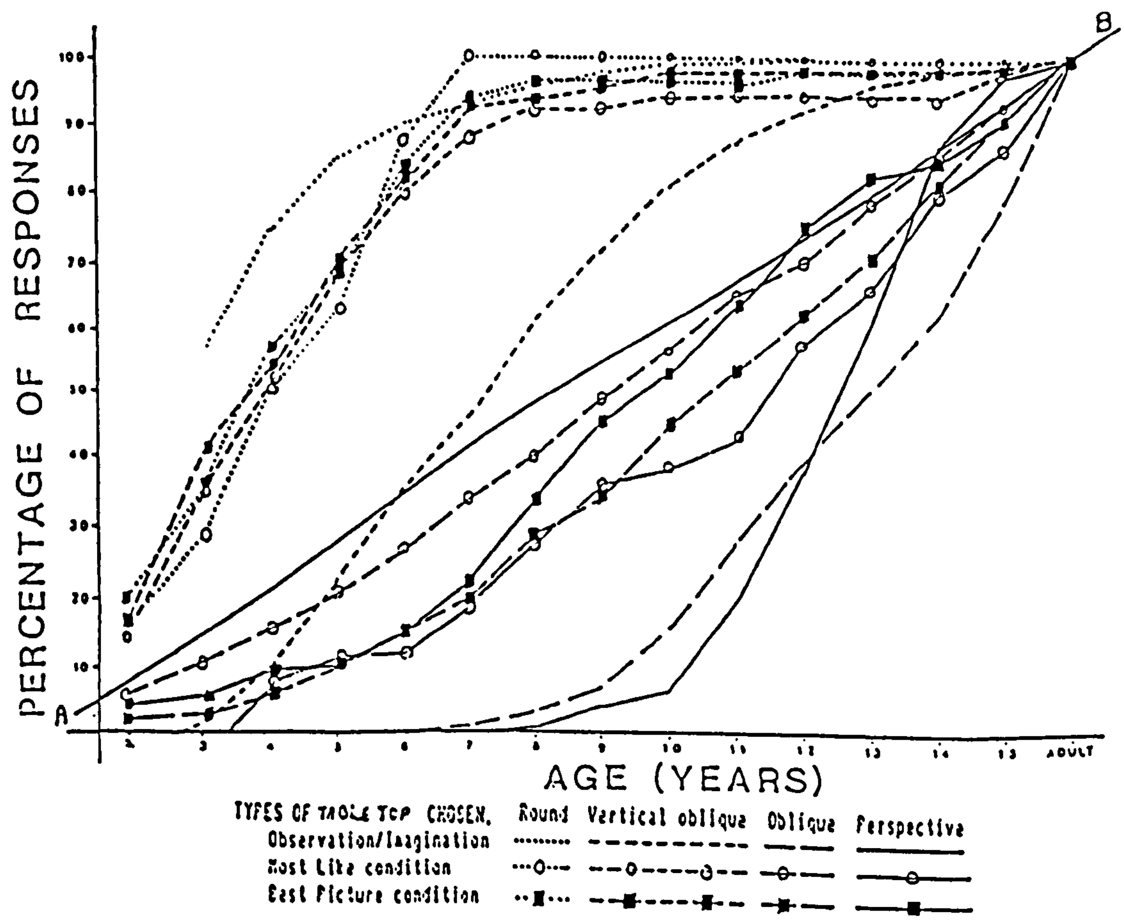


Figure 7:7. *Cumulative proportions of preference, with age, for different table tops, across M.L. and B.P. conditions, and for amalgamated data for tables drawn from observation and imagination. See text for details of AB.*

table tops are more varied. The Most Like task encourages an earlier oblique top response than does the Best Picture task, with approximately two years difference between the two. The amount of variation in responses for the perspective table top in both tasks prevents the drawing of clear conclusions. However, with minor variations, it can be seen that from about 7 years upwards the Best Picture task encourages an earlier

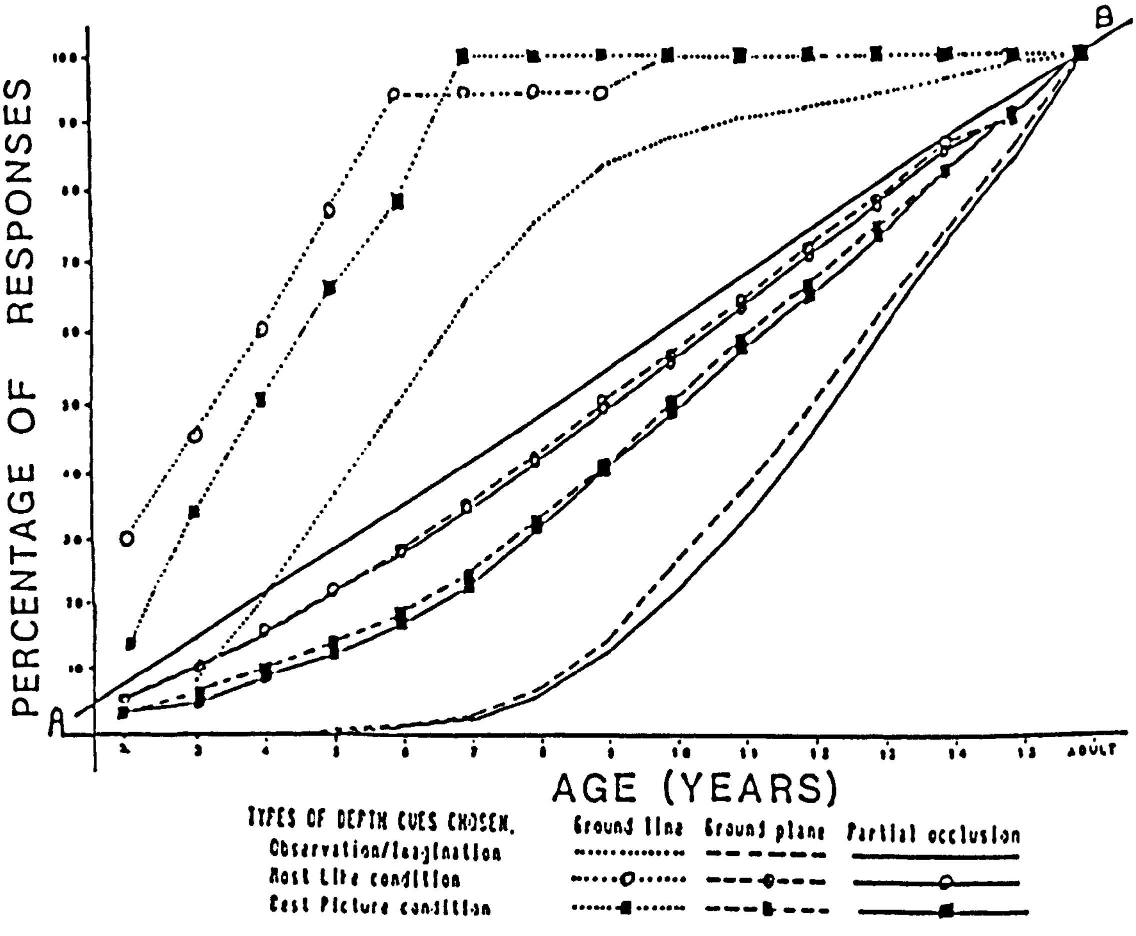


Figure 7·8. *Cumulative proportions of preference, with age, for different depth cues, across M.L. and B.P conditions, and for amalgamated data for tables drawn from observation and imagination. See text for details of AB.*

perspective choice than does the Most Like task. All four responses closely follow the path of diagonal axis AB, illustrating relative lack of development, but the response for the oblique table top, Most Like task, shows virtually no development.

Figure 7:7 shows that preference is well in advance of production for vertical oblique, oblique, and perspective table tops. The reverse is true for the round table top, where production is in advance of preference. This seems counter intuitive, and whilst it shows up clearly here it might be a function of the stimulus. In each task the percentage of the total accounted for by the round response is very small (ML = 0.02%, BP = 0.13%, Production = 0.1%), but the difference between them is very definite. An examination of the age profiles given in Figures 7:2, 7:3, and 4:3 shows that whilst the majority of subjects drawing round table tops are three years old, with the response rapidly tailing off after that, the preference response obtained here stays steady until subjects are approximately eight years old. A table top frequently produced by younger children is one in orthographic projection, but this was not included here for the reasons given earlier. It is possible that if such a line drawing had been available subjects would have chosen that rather than the round table top.

The cumulative age profiles for ground line, ground plane, and partial occlusion shown in Figure 7:8 show very clearly that there is little development in the preference for ground plane and partial occlusion on the Most Like task, in that nearly all subjects at all ages choose these cues. It also shows that in each case the Most Like question elicits a response at an earlier age than does the Best Picture question, and that in all cases preference is well in advance of production.

Discussion.

It has been clearly shown that adults prefer a picture of a table in oblique projection, using ground plane and partial occlusion. Not only is linear perspective not the form of projection commonly used by adults but it appears that adults do not think that it is the best way in which to represent a table. Indeed the response for a table top in perspective is higher when older subjects are asked which is the best picture of a table than asked which drawing is most like a table. These findings support those of Hagen and Elliot (1976) and cast doubt upon the possibility that older subjects develop a preference for linear perspective.

Very young children do not show a strong preference for oblique projection, but this does not support the suggestion put forward by Hagen and Jones (1978) that such children have difficulty interpreting the pictorial station point. The stimuli Hagen and Jones used gave the children no alternative other than to choose between varying degrees of oblique projection and perspective. Given other alternatives young children do show a drop in preference for oblique, but do not show an equivalent increase in preference for perspective, as would be expected if preference for perspective was reflecting an inability to take account of the pictorial station point. This indicates that the very young children might have been basing their choice on different criteria to those used by the older subjects.

It has been shown that the wording of the question does affect the answer. Subjects at all ages make responses more similar to a table in oblique projection when asked which drawing they think looks most like a table, as opposed to which is the best picture of a table. In the latter case there is more variation in response, particularly for the younger subjects. There is also more variation in the response for the perspective table top and in the differential response for 3h and 3j. This suggests that the way in which a subject interprets the question does affect the answer and has implications for the assumption that the subjects preferred form of depiction is unchanging. This links with the last topic addressed which was whether or not the subject's preference develops with age, and if so, how.

In the introduction it was suggested that there were, broadly, two conflicting sets of findings about the relationship between preference and production. The first found that preference was in advance of production for young children or that children of all ages preferred the most advanced drawing. The second was that children prefer drawings that have the most in common with their own drawings. Taylor and Bacharach (1981) obtained a combination of these results. The first set of findings reflects the data presented here more accurately. Here it has been shown that the majority of all children tested preferred a table in advance of the production of others of their age, and that subjects from seven years old upwards preferred the most advanced form of drawing (as measured by that produced and preferred by adults). However, this study also indicates a possible reason for the conflicting sets of findings. The form of question has a major effect upon the preferences shown by the younger children. The number of responses made on each condition appears to reflect children's own production more accurately when asked which line drawing is the best picture of a table than when asked which is most like a table. As noted in the introduction, all the studies that found a close relationship between preference and production asked subjects which they thought was the best picture. It is possible that the use of this question biased subjects towards their own form of production. 'Best' does not have to imply the most visually realistic, or the one adults use ..... it could mean the most symmetrical, or the easiest to draw!

This study indicates that whilst subjects of all ages have a clear idea of what sort of representation looks most like a table to them, this is not necessarily reflected in the productions of children of their age.

The main questions left unanswered by this study are: why is there such a strong preference for visually (as opposed to perceptually) unrealistic oblique projection, and why do subjects not depict a table in the manner which they think looks most like a table? The remainder of this chapter is devoted to examining the first question in greater depth.

In particular the remaining three studies are designed to examine the strength of the preference for oblique projection is the face of cues that accentuate its lack of visual realism.

The second question forms the basis of the following chapters, but it is worth pointing out here that both views about the relationship between production and preference appear to be partially supported and so both assumptions mentioned in the introduction need to be examined. Is there something preventing the subject from producing the drawing that he or she thinks would look most like a table, or are subjects generally happy with their production, feeling that it best represents what they want to depict? If that is the case, what is it that they are actually trying to depict?

STUDY 7: 2

Preference for table type, with age, related to degree of shading.

Introduction.

Oblique projection is visually unrealistic in that it is impossible ever to see a table in this projection, yet in the last section it was shown that the vast majority of subjects thought that the line drawings that looked most like a table were those in which the table top was depicted in oblique projection. This study and the following ones were designed to investigate whether this strong preference for oblique projection can be moderated by accentuating its lack of visual realism. This study investigates the degree of preference for oblique projection when depth in the line drawings is heightened by the use of a secondary depth cue, namely the degree of shading in the stimulus. The nearer we are to part of an object the darker it appears. Normally this goes unnoticed, but does become evident under some circumstances. For example, it can be seen out of doors in the early morning, before there is enough light for the colour to become fully evident, and especially if there is a mist. Under these circumstances the view appears to be composed of cardboard cutouts, receding into the distance, the feeling of depth being given by the silhouettes becoming progressively lighter the further away that they are.

It was decided to use a secondary depth cue to emphasise visual realism, because, as described earlier, the primary depth cues of ground plane and partial occlusion are co-variates of a table in oblique projection and so could not be used. Another secondary depth cue is that of texture gradient, in which nearer objects are seen to have greater texture. Rock *et al* (1973) presented subjects with pictures representing a scene in depth in which the texture gradient had either been eliminated or inverted. It was found that illusory size perception based on the localisation of objects in depth did occur, but only if the scene was recognised. Without recognition no impression of depth was achieved. Therefore they concluded that texture gradients were neither a necessary nor sufficient cue for depth perception. It is probable that the use of shading is also not sufficient for the perception of depth, but it was felt that whilst the use of shading is not particularly obvious to the subject it might subconsciously affect the degree of perceived visual realism.

Method.

Subjects. The subjects were 210 children , ranging in age from four to ten years old, taken from a state primary school on the outskirts of Leyland. This age range was chosen because it was shown in the previous study that by ten years of age there was little variance in the data, and so there was no real need to extend the subject population upwards. Pre-school children were excluded because the large amount of time needed to obtain meaningful data from them was not balanced by trends in the data attributable only to children of these ages. Teachers were asked to choose thirty children from each of the age groups who were representative of the school population.

Stimuli Eight line drawings were selected to coincide with the types of depiction chosen by children between four and ten years of age in the previous study. Table tops separated from the legs were therefore excluded, as were round table tops. A line drawing in orthographic projection was included to investigate the response to this, and a variety of table tops in oblique projection were included for the same reason.

Two groups of stimuli were used. In the first the line drawings were presented unshaded and in the second they were partially shaded. An example can be seen in Figure 7:9. Within each group the drawings were arranged in two different ways to prevent positional bias.

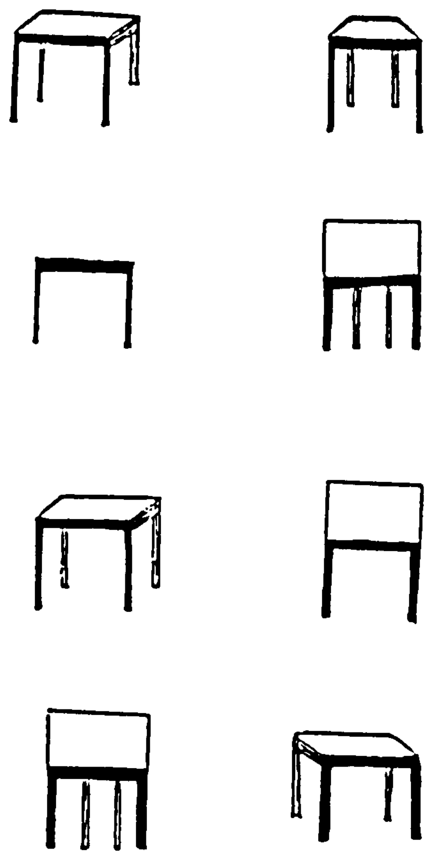


Figure 7:9. *An example of the shaded stimulus used in Study 7:2.*

Procedure Each subject was seen separately. He or she was asked to sit down and was then shown the stimulus. The choice of which stimulus to use was balanced across age, sex, stimulus group and positional group. The subject was told that 'These are all tables drawn by children' and asked 'Which drawing do you think looks most like a table?' Once he or she had left the room the choice made by the subject was noted along with age, sex, and type of stimulus used.

Results.

The data obtained in this study can be found in Appendix 7:B.

Figures 7:10 and 7:11 show, under both shaded and non-shaded conditions, that more subjects at all ages preferred a line drawing that showed the use of ground plane and a table top in oblique projection. The response for ground plane was higher than that for oblique projection, but this might be an artifact of the stimulus because all line drawings showing oblique projection also showed ground plane and the opposite was not the case.

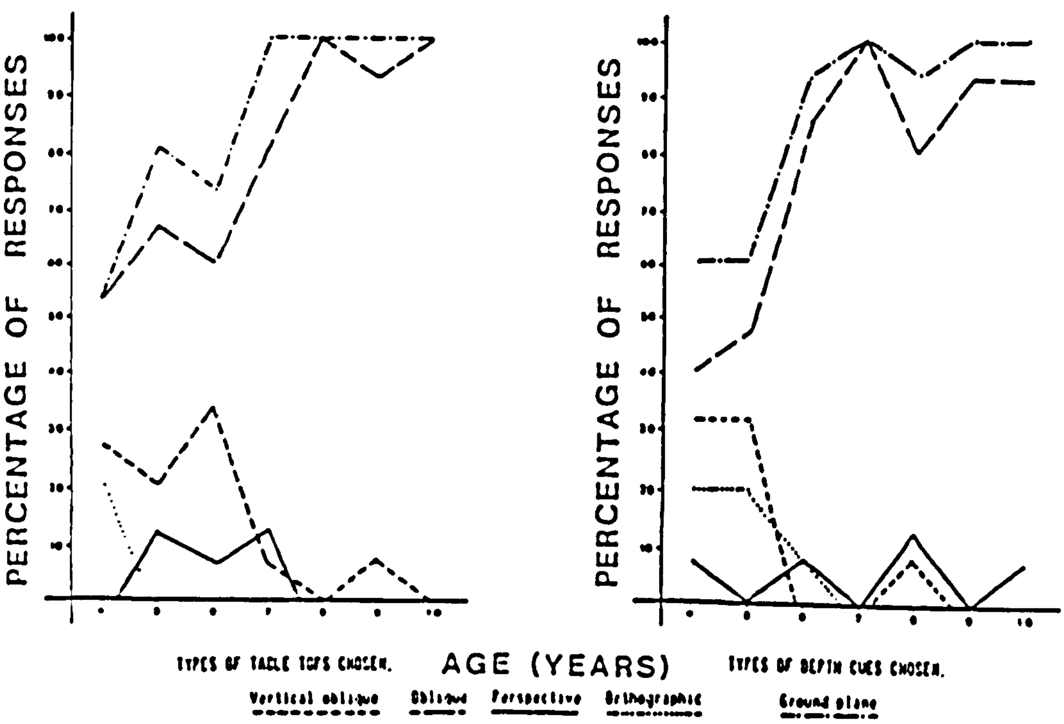


Figure 7:10. The proportions of subjects, with age, choosing different types of table tops and ground plane when given the shaded stimulus.

Figure 7:11. The proportions of subjects, with age, choosing different types of table tops and ground plane when given the non-shaded stimulus.

$K\chi^2$ tests on the proportions of response, with age, failed to find any significant differences between the two conditions for the oblique or ground plane responses (Oblique Shaded vs. Non-shaded, $K\chi^2 = 3.96$, df = 2, $p > 0.05$; Ground plane, $K\chi^2 = 0.49$, df = 2, $p > 0.05$).

Because of the small numbers involved a similar comparison for the other responses was felt to be less valid. The $K\chi^2$ test can be used for small samples (Siegal 1956), it identifies any differences in the data. When applied to the data given here it shows significant differences between all of the other groups (Orthographic, $K\chi^2$ = 66.59, df = 2, $p < 0.001$; Vertical oblique, $K\chi^2$ = 24.98, df = 2, $p < 0.001$; Perspective, $K\chi^2$ = 10.67, df = 2, $p < 0.01$) as might be expected when dealing with small numbers of subjects in a task which allows so much variation. The Fisher Exact Probability test is most sensitive to variation in central tendency, and was therefore felt to be most appropriate here. When this test was applied to responses obtained from subjects aged between 4 and 6 and between 7 and 10 years old it failed to find any significant differences between the two conditions (Orthographic, AB = 7:0, CD = 3:0, $p > 0.05$; Vertical oblique, AB = 12:2, CD = 10:1, $p > 0.05$; Perspective, AB = 2:3, CD = 3:2, $p > 0.05$). It can be concluded that there is very little difference in response whether the stimulus is shaded or not. The difference that there is may well be partially generated by random fluctuation due to such small numbers.

Three forms of oblique table top were provided in the stimuli to enable the oblique response to be examined further. Two tables in true oblique projection were included, one with the back extended diagonally to the right and the other with the back to the left. A $K\chi^2$ test failed to find any difference in response between the two ($K\chi^2$ = 2.37, df = 2, $p > 0.05$). The other variation on oblique projection is that of 3j mentioned in the previous study. A $K\chi^2$ test failed to find any differences in response between this and the 'true' oblique stimuli ($K\chi^2$ = 0.65, df = 2, $p > 0.05$).

Finally $K\chi^2$ tests show few significant differences between the data obtained here and those obtained in the Most Like condition in the last study. Tests failed to find significant differences between either condition on the ground plane and the oblique top responses. Significant differences were found between Non Shaded vs. Most Like on the vertical oblique tops, and between Shaded vs. Most Like on the perspective top, but these last two are based on small subgroups, hence it is difficult to draw a conclusion from these results. (Shaded vs. Most Like:- vertical oblique, $K\chi^2 = 1.28$, $df = 2$, $p > 0.05$; oblique, $K\chi^2 = 0.96$, $df = 2$, $p > 0.05$; perspective, $K\chi^2 = 11.93$, $df = 2$, $p < 0.01$; ground plane, $K\chi^2 = 1.9$, $df = 2$, $p > 0.05$; Non Shaded vs. Most Like:- vertical oblique, $K\chi^2 = 17.93$, $df = 2$, $p < 0.001$; oblique, $K\chi^2 = 2.65$, $df = 2$, $p > 0.05$; perspective, $K\chi^2 = 3.14$, $df = 2$, $p > 0.05$; ground plane, $K\chi^2 = 1.9$, $df = 2$, $p > 0.05$).

Discussion.

The main findings from this study are the strong preference for oblique projection and ground plane shown, regardless of whether the stimuli are shaded or not, and the lack of difference between this study and the previous one in preference for these aspects of line drawings. Differences which were found between the two conditions presented here, and between them and the previous study, are not reliable because of the small number of subjects.

In the introduction it was stressed that degree of shading was a secondary depth cue and hence was not necessary, and probably not sufficient, for the perception of depth, but it was felt that its use might encourage preference for a more visually realistic form of depiction. This has been shown not to be the case. However, the shading used in this study was not particularly realistic, with sharp breaks in the degree of the shade, hence it is possible that the shading provided a distraction rather than an indication of depth. Alternatively, the subject's preference for an oblique form of table might be sufficiently strong to override cues for greater visual realism.

The following study investigates whether a stronger cue for visual realism, presenting the line drawing against a background in linear perspective, can encourage a more visually realistic preference.

STUDY 7: 3

Preference for table type related to a background in linear perspective.

Method.

Subjects. The subjects were 833 children, from 4 to 14 years of age, taken from one primary school and one secondary school, in Blackburn and Leyland, respectively. As such the subjects form a representative sample of the school population of the area. All subjects were experimentally naive. The 4 to 10 year olds form one subject group (A), and the 11 to 14 year olds form the other (B).

Stimuli. Two forms of stimuli were used, one with line drawings of

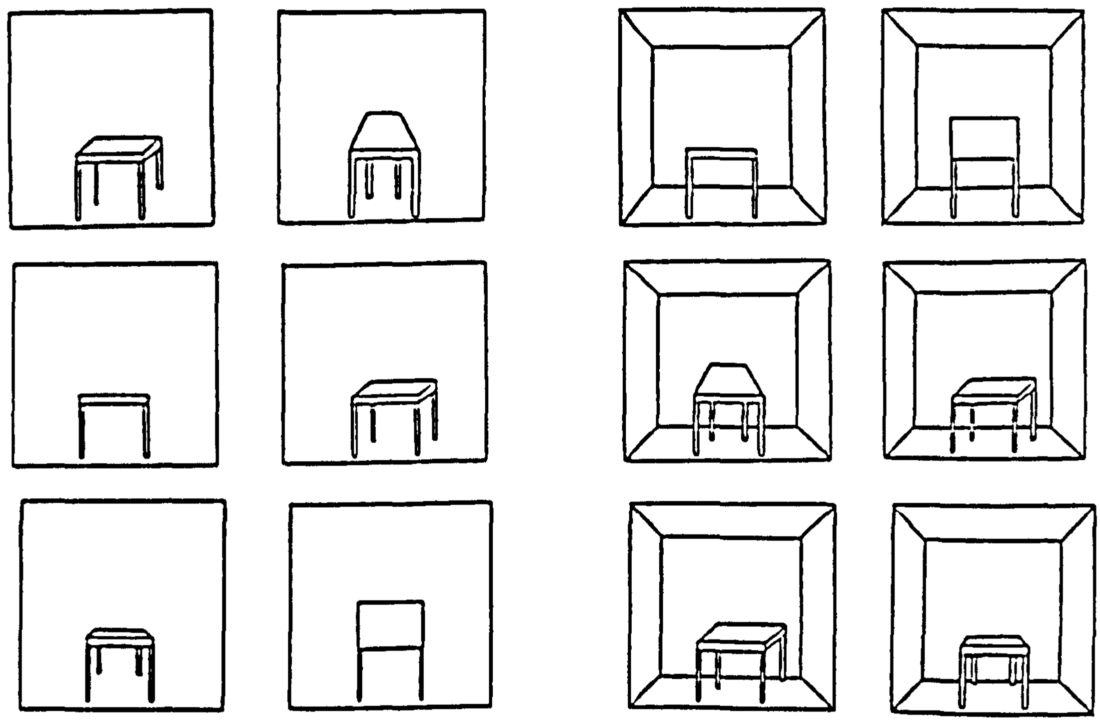


Figure 7:12. *Examples of the stimuli used in Study 7:3.*

tables each enclosed within a square border, and the other similar to the first, but including lines indicating the sides of a room in linear perspective. The position of the line drawings within each stimulus was varied thus giving four main types of stimuli. The main types of stimuli are shown in Figure 7:12. The line drawings used in this study represent a table drawn correctly in orthographic, vertical oblique and oblique projection, and in linear perspective (1a, 2a, 3h, and 4k respectively). Two common variations of the last two forms were included in the stimulus. A drawing in 'naive' perspective (4k[n]), in which the orthogonals converge but do not meet at one vanishing point, was included as was a drawing classed as 3j, in which the inner back leg of a table drawn in oblique projection is extended. In both cases studies described earlier have shown that a large number of subjects draw in these forms when trying to produce perspective or oblique projection. However, a line drawing of the type 3j was not included on the stimuli given to subject group B. This omission is discussed later.

Procedure. Each subject was seen individually. The particular stimulus sheet used was balanced across sex, age, and ability. The subject was shown a sheet and was told 'These are all tables drawn by children' and then asked 'Which drawing do you think looks most like a table?'. Generally subjects examined the sheet and then pointed to their choice. A few subjects, particularly in the younger age groups, took some time in choosing. If this happened they were prompted by 'Point to the one you think looks most like a table'. The subject's choice and age were then recorded.

Results.

The data obtained in this study can be found in Appendix 7:C.

Figure 7:13 shows the proportions of responses, with age, for the choice of oblique (3h & 3j) and perspective (4k & 4k[n]) table tops. It can be seen that the majority of subjects at all ages chose a table in oblique projection. The proportions of subjects choosing line drawings

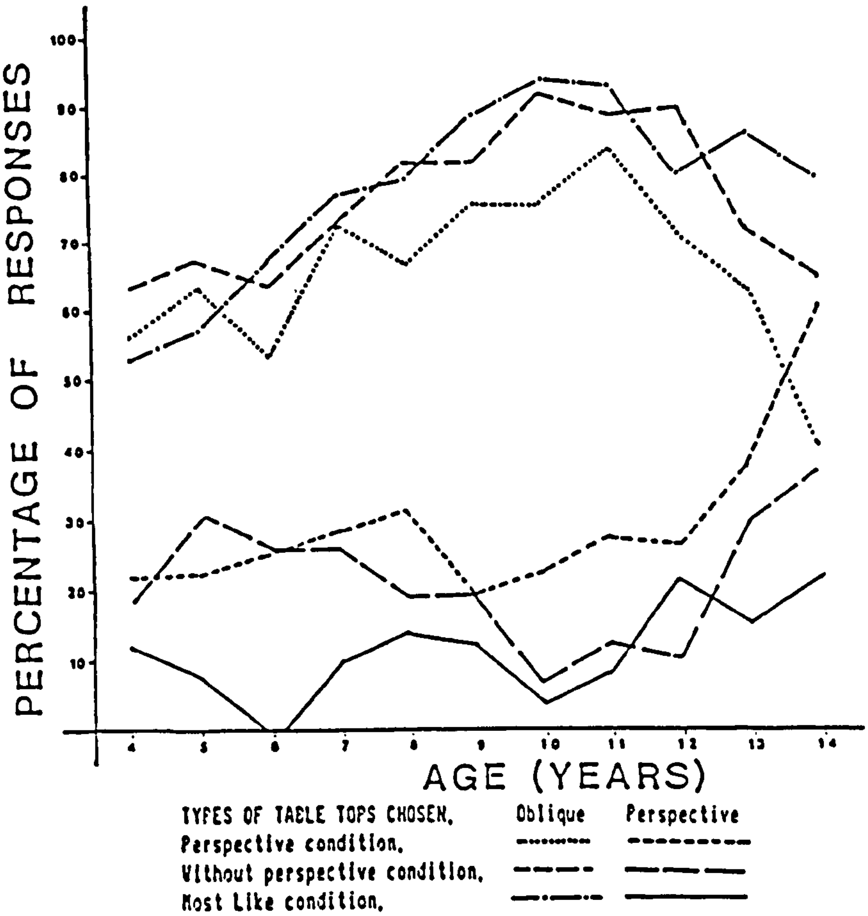


Figure 7:13. Proportions of preference, with age, for table tops in oblique or perspective forms of projection, under perspective and non-perspective conditions in this study, and under M.L. condition in Study 7:1.

in orthographic or oblique projection have been excluded from this figure, because of the small numbers involved. From this figure it can also be seen that more subjects chose a line drawing in oblique projection when the background was blank, and more subjects chose a line drawing in perspective when the background was in perspective. However $K\chi^2$ tests comparing the two tasks by examining the number of subjects, with age, choosing each line drawing failed to find any significant differences between the two tasks (A background in linear perspective as opposed to a blank background: 1a, $K\chi^2 = 0.96$, df = 2, $p > 0.05$; 2a, $K\chi^2 = 2.64$, df = 2,

$p > 0.05$; 3h, $K\chi^2 = 0.19$, df = 2, $p > 0.05$; 3j, $K\chi^2 = 0.36$, df = 2, $p > 0.05$; 4k, $K\chi^2 = 2.37$, df = 2, $p > 0.05$; 4k[n], $K\chi^2 = 1.62$, df = 2, $p > 0.05$).

A closer analysis of the oblique and perspective responses shows that approximately one third of the subjects who preferred an oblique table top chose a line drawing of the form 3j, rather than 3h. However, tests failed to find any significant differences in the number of subjects, with age, who chose each of these types (Perspective background: 3h vs. 3j, $K\chi^2 = 1.88$, df = 2, $p > 0.05$; Blank background: 3h vs. 3j, $K\chi^2 = 0.5$, df = 2, $p > 0.05$). An examination of the perspective responses (4k and 4k[n]) shows that nearly three quarters of the subjects preferred a table in naive perspective to one in true linear perspective, but similarly tests failed to show any significant differences between the two forms of perspective response, with age (Perspective background: 4k vs. 4k[n], $K\chi^2 = 3.38$, df = 2, $p > 0.05$; Blank background: 4k vs. 4k[n], $K\chi^2 = 2.23$, df = 2, $p > 0.05$).

The data for choice of oblique or perspective table tops were also compared with those obtained in Study 7:1 when subjects were asked which line drawing they thought looked most like a table. The paucity in the number of subjects choosing tables in orthographic or vertical oblique projection means that a similar comparison for these forms of projection is inappropriate. $K\chi^2$ tests failed to find any significant differences between Study 7:1 (Most Like condition) and the two conditions presented here in the proportions of response, with age, for oblique or perspective table tops (Study 7:1 [ML] vs. line drawing with a background in perspective: oblique, $K\chi^2 = 3.88$, df = 2, $p > 0.05$; perspective, $K\chi^2 = 1.71$, df = 2, $p > 0.05$; Study 7:1 [ML] vs. line drawing with blank background: oblique, $K\chi^2 = 1.51$, df = 2, $p > 0.05$; perspective, $K\chi^2 = 2.61$, df = 2, $p > 0.05$). Because the 3j line drawing was only used with subject group A the responses obtained for it were also compared with those obtained in Study

7:1, however tests again failed to find any significant differences between the proportions, with age, in each condition (Study 7:1 [ML] vs. line drawing with a background in perspective: $K\chi^2 = 0.36$, df = 2, $p > 0.05$; Study 7:1 [ML] vs. line drawing with blank background: $K\chi^2 = 0.65$, df = 2, $p > 0.05$).

Discussion.

The most obvious aspect of these data is the failure to find any significant differences between the two conditions, and between the responses obtained in this study and those obtained under the Most Like condition in Study 7:1. The majority of all subjects, of all ages, under all conditions, preferred a table presented in oblique projection even when this projection conflicted with the projection used on the surrounds. Increasing the visual realism of the stimulus does not significantly increase the preference for a more visually realistic line drawing, although there is some indication of a marginal increase.

It is interesting to note the lack of age trends in the data. Line drawings in the form of 3j and 4k[n] had been introduced because of the suspicion that the younger subjects might prefer an 'earlier' form of oblique drawing, in the case 3j, and/or a line drawing more similar to the one that is normally produced, in the case of 4k[n]. Neither of these suspicions was supported. The number of subjects preferring 3j was steady across all age groups, and was not significantly different to that obtained in Study 7:1. Similarly, the number of subjects preferring 4k[n] was steady across all age groups, thus showing no age trends. The strong preference for 4k[n] rather than 4k is, however, interesting.

4k[n] is not visually realistic. Earlier it was suggested that a 4k choice indicated a subject's preference for a more visually realistic table type, but, in earlier studies, 4k[n] was not offered as one of the alternatives to 4k. Chase (1983) found that subjects generally perceive that objects are more rectangular than they actually are, and the preference for 4k[n] rather than 4k, in the minority of subjects who choose a 'perspective' line drawing, supports these findings.

It is unclear what preference for a line drawing in linear perspective indicates. As shown in Chapter 3, a table drawn in linear perspective only approaches visual realism if the coordinates of the table and its relationship to the eyes of the observer are known exactly. This is not the case here. Further, Chapter 4 showed that one of the most salient differences between a table in oblique projection and one in linear perspective is the position of the view point. Chapter 5 showed that position of viewpoint was not a significant factor in the task dependency shown when a table is drawn from observation or imagination, but, this may not be the case for preference (as opposed to production) tasks. From these points it can be argued that by choosing 4k subjects might be indicating a preference for a central view point, rather than for a more visually realistic depiction.

The final study in this chapter was chosen to examine this question, as well as performing a further function. It is perhaps optimistic to expect either a modicum of shading or a few lines indicating a background in perspective to significantly affect a subject's preference for visual realism, and the stimulus itself, as a line drawing, is inherently visually unrealistic. Therefore in the following study a real table is included as part of the stimulus to investigate whether this will affect the degree of preference for a visually realistic depiction.

STUDY 7: 4.

Preference for table type when comparing the stimulus with a real table.

Method.

Subjects. 384 subjects were used, 32 in each year from 4 to 14 years of age, and 32 adults. They were taken from one primary school and one secondary school on the outskirts of Blackburn and Leyland respectively, and from classes of Adult Returners in a Further Education College in Leyland. As such the children form a representative sample of the school population in the area. The adults are biased towards those interested in self improvement, and may be more able than the general population. All subjects were experimentally naive.

Stimuli. One part of the stimulus consisted of twenty line drawings of a table, selected from common forms of production to give a variety of examples of types of table tops and table legs, as can be seen in Figure 7:14. Two forms of this were developed to prevent positional bias in the subjects' choice. The other part of the stimulus replicated the stimulus used in Chapter 3 when subjects drew a table from observation. A full description of the stimulus and the method by which it was used can be found in that chapter. Briefly, the stimulus consisted of a real rectangular table placed with the long side directly in front of the subject with the subject seated as closely as possible to the position from which they would see the orthogonals converging at 115 degrees. One of the line drawings was designed to replicate as closely as possible the view each subject had of the table.

Procedure. Each subject was seen individually. The particular stimulus sheet used was balanced across age, sex, and ability. Each subject was seated as accurately as possible without drawing their attention to the table in front of them. Some subjects realised that the table was part of the experiment. Half the subjects in each age group were then told 'These are all tables that children have drawn. Look very carefully at them. Which do you think looks most like that table over there?'. The other half were told 'Look very carefully at the table over there. These are all tables that children have drawn. Which of these do you think that table looks most like?'. These two forms of wording will be referred to as the two conditions Sheet First and Table First. Once the subject had left the room the type of stimulus sheet, type of question, and the subject's age and choice were then recorded.

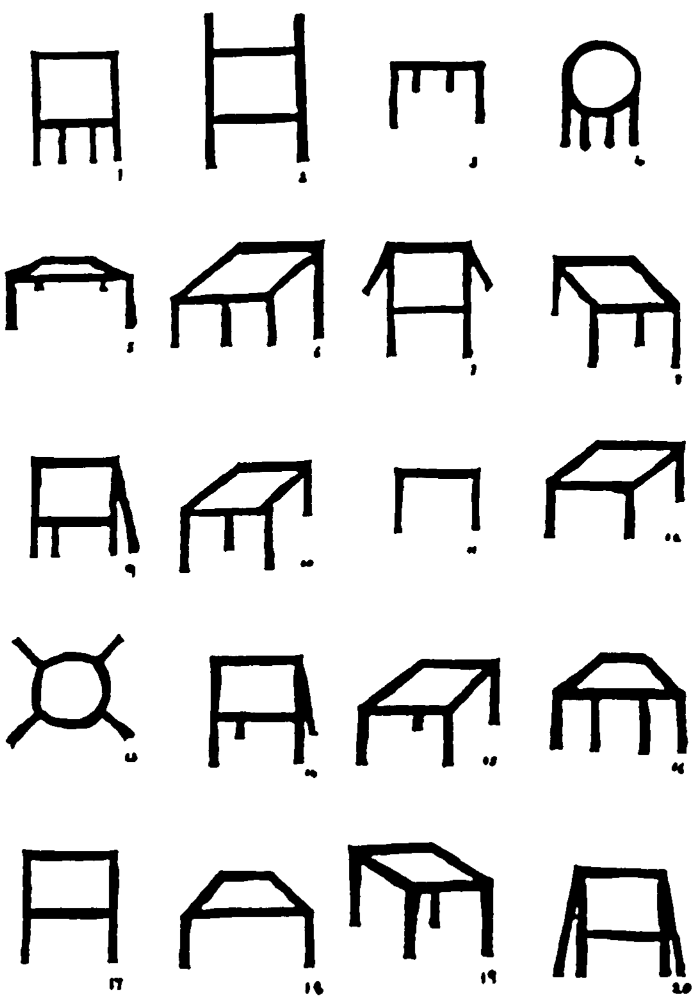


Figure 7:14. *An example of the stimulus sheet used in Study 7:4.*

Results.

The data obtained in this study can be found in Appendix 7:D.

Under both conditions and both forms of stimulus the majority of subjects chose a line drawing with the table top in oblique projection. A $K\chi^2$ test on the number of subjects in each age group choosing line drawings with an oblique table top failed to find any significant differences between the two forms of stimulus ($K\chi^2 = 0.42$, df = 2, $p > 0.05$). The small number of subjects responding on the other forms of table tops invalidated similar comparisons on these. It was, therefore, assumed that there was no significant positional bias and the results for both forms of stimulus were amalgamated.

A series of $K\chi^2$ tests failed to find any significant differences between the two conditions (Comparison of the two conditions in the number of subjects in each age group choosing:- Orthographic table top, $K\chi^2 = 2.73$, df = 2, $p > 0.05$. Vertical oblique table top, $K\chi^2 = 0.77$, df = 2, $p > 0.05$. Oblique table top, $K\chi^2 = 0.24$, df = 2, $p > 0.05$. Perspective table top, $K\chi^2 = 2.22$, df = 2, $p > 0.05$. Round table top, $K\chi^2 = 0.0$, df = 2, $p > 0.05$. Ground line, $K\chi^2 = 4.49$, df = 2, $p > 0.05$. Ground plane, $K\chi^2 = 0.78$, df = 2, $p > 0.05$. Partial occlusion, $K\chi^2 = 0.12$, df = 2, $p > 0.05$). The data for the two conditions were, therefore, amalgamated.

Kolmogorov Smirnov χ^2 approximation tests also failed to find significant differences between preference, with age, for line drawings in oblique projection that faced either to the left or to the right ($K\chi^2 = 4.27$, df = 2, $p > 0.05$) or for line drawings in oblique projection with an extended back leg that faced either left or right ($K\chi^2 = 0.24$, df = 2, $p > 0.05$). However, significant differences, with age, were found when the responses for oblique projection and oblique projection with an extended back leg were compared ($K\chi^2 = 7.57$, df = 2, $p < 0.05$).

Figure 7:15 shows that the majority of younger subjects prefer a table top in oblique projection. This preference declines with age, however, whilst the preference for a table top in perspective increases with age. At all ages the vast majority of subjects prefer a line drawing of a table that shows a ground plane and partial occlusion.

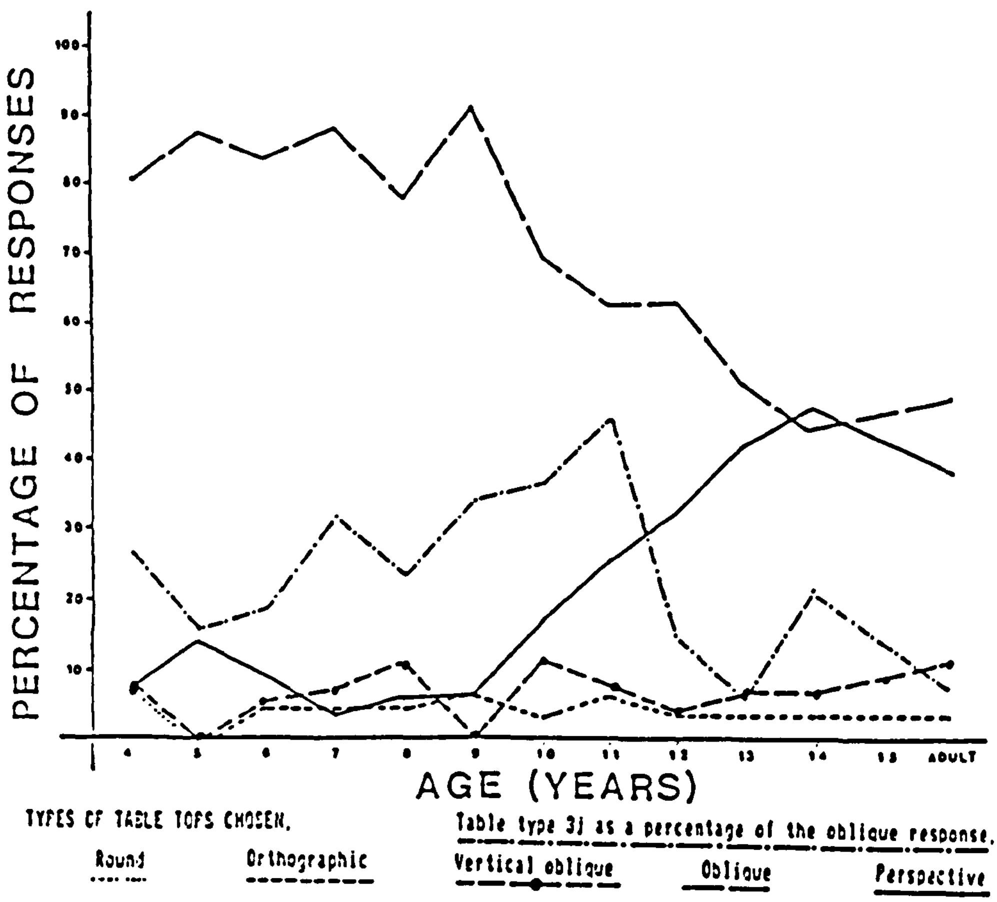


Figure 7:15. The proportions, with age, of preference for different types of table top when a line drawing is compared with a real table. Also showing the preference, with age, for 3j as a percentage of the total oblique response for each age group.

Figure 7:15 also shows that whilst the proportions of subjects choosing the first type of line drawing remains moderately constant with age, choice on the latter form does vary with age. Until about nine years of age approximately a third of all children who prefer a table top in oblique projection also prefer it with the extended back leg. This preference increases to almost fifty percent for children between ten and eleven years old, and then drops away rapidly with increasing age.

It is interesting to compare these results with those reported earlier, obtained when subjects were just asked to choose which line drawing they thought looked most like a table. Figure 7:16 shows a comparison of the proportions, with age, of the oblique and perspective responses obtained in the two studies. It can be seen that there are major differences between the two studies in these responses. In particular the high oblique and low perspective responses obtained in the

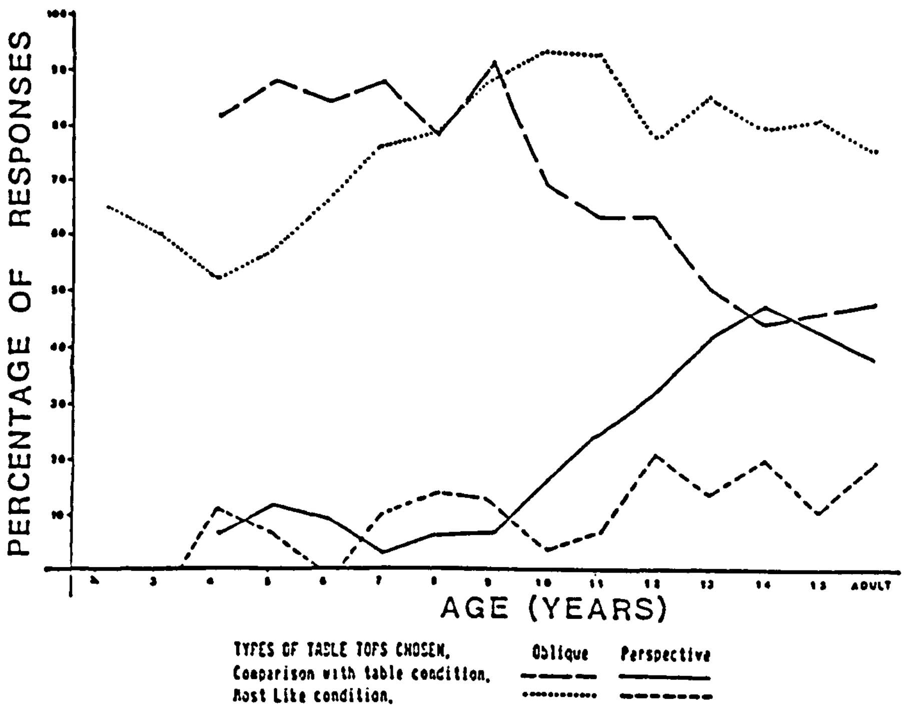


Figure 7:16. The proportions, with age, of preference for oblique or perspective table tops shown in this study and in Study 7:1, M.L. condition.

earlier study are modified with age when subjects are asked to compare the line drawings to a real table. Kχ^2 tests show significant differences between the two studies in the proportions of subjects, with age, choosing each type of table top, but failed to find such differences in preferences for ground plane or partial occlusion (Proportions of responses when asked which line drawing looks most like a table vs. those obtained when also asked to compare the line drawings to a real table; Oblique: Kχ^2 = 39.7, df = 2, $p < 0.001$; Perspective: Kχ^2 = 14.38, df = 2, $p < 0.001$; Ground

Plane: $K\chi^2 = 3.34$, df = 2, $p > 0.05$; Partial Occlusion: $K\chi^2 = 5.01$, df = 2, $p > 0.05$).

Data from the present study also indicate, as can be seen in this figure, that from about ten years of age subjects appear to be increasingly sensitive to the task constraints. This supports the findings presented in Chapter 5 which indicate that it is at about this age that subjects become sensitive to centrality of viewpoint when drawing a table. This study was also designed to investigate the extent to which centrality of viewpoint and/or visual realism were preferred. Several of the line drawings used in this study presented a central viewpoint, yet only one replicated as accurately as possible the view of the table that the subjects actually possessed.

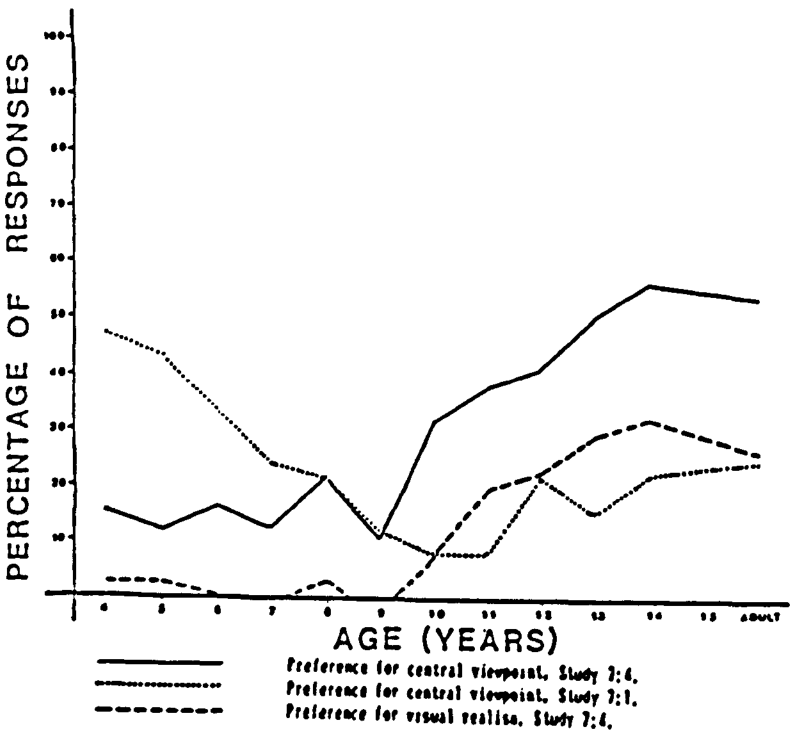


Figure 7:17. The proportions with age, of preference for a central viewpoint shown in this study and in Study 7:1, M.L. condition, and for a visually realistic line drawing shown in this study.

It can be seen in Figure 7:17 that there are differences, in both degree and trend, between the proportions of subjects, with age, preferring centrality of viewpoint rather than a visually realistic line drawing ($K\chi^2$

= 15.64, df = 2, $p < 0.001$). It can also be seen that whilst there is a minority of subjects of all ages who prefer a line drawing with a central viewpoint, the preference for visual realism increases steadily from about ten years of age. Figure 7:17 also relates these findings to those obtained in Study 7:1 when subjects were asked which line drawing they thought was most like a table. An investigation of preference for visual realism is not applicable here, but the proportions of subjects, with age, preferring centrality of viewpoint are significantly different to those obtained in the present study ($K\chi^2 = 99.74$, df = 2, $p < 0.001$). When subjects are able to compare the line drawings with a real table, presented with a central viewpoint, fewer younger subjects choose a line drawing with a central viewpoint if they have no table for comparison. This effect is reversed in older subjects.

Discussion.

In this study subjects were asked to choose which line drawing they thought looked most like a real table. A real table was introduced into the stimulus to enable an investigation to be made into the effects of increasing visual realism on subjects' preference for particular line drawings. The effect upon the younger subjects was possibly contrary to expectations, in that under these conditions a greater proportion of younger subjects chose a line drawing with non central viewpoint and a table top in oblique projection than when the subjects had no table with which to match the line drawing. At about ten years of age this effect is reversed. An increasing proportion of older subjects chose a visually realistic description of the table they saw in front of them, although 47% of adults still displayed a preference for a line drawing in oblique projection. Tests failed to find any significant differences between the two studies in the strong preference, at all ages, for ground plane and partial occlusion.

Earlier the oblique table top with the extended back leg (3j) was described as a possible indication of a developing preference for visual realism, or at least an increasing ability to interpret a desire for visual realism within the task demands. It is interesting to note that the proportion of subjects showing a preference for this form of line drawing is at its highest between nine and eleven years of age, lending support to this suggestion.

The increased visual realism involved in relating line drawings to the perception of a real table appears to encourage subjects to choose the non visually realistic, but highly pervasive, oblique projection. A real object produces higher levels of conceptual awareness than do line drawings or photographs (Davies and Rushton 1980, Walker and Walker 1988). This supports arguments presented earlier that oblique projection is the best two dimensional representation of how we 'perceive' tableness. Although subjects are presented with a real, and hence visually realistic, stimulus, the data suggest that these subjects felt that oblique projection was the most conceptually realistic description of the table. In Study 7:1 a greater proportion of younger subjects chose line drawings with a central viewpoint, but the majority of these drawings were visually unrealistic and resembled, or were slightly in advance of, the forms of production used by children of these ages. It is suggested that the majority of subjects presented with line drawings to match against a real table were less concerned with how they themselves would like to draw it than with what they felt was a good match. Their criteria for a good match was in terms of how well the line drawing accessed their idea of tableness, and for only a small percentage of subjects in every age group was this related to centrality of viewpoint. Parallels can be seen between this finding and that of Light and Nix (1983) who found that, in a perspective-taking task, young children chose the 'best' view, as opposed to their own view, if their own view did not represent the objects clearly and separately. Here subjects of all ages can be seen to be judging the stimuli according to criteria other than that of visual realism.

General Discussion.

There appear to be no strong developmental trends in preference for particular depth cues. In all the studies presented in this chapter subjects of all ages show a strong preference for ground plane and partial occlusion. However preference for forms of projection is more complex. Generally, the majority of subjects, across all conditions, prefer a line drawing in oblique projection. This is the case even when older subjects are asked to match the line drawing with a real table viewed from the centre. However, there do appear to be task related developmental trends within this general rule. It would appear that the less salient the visual realism of the stimulus, the more the younger subjects show preferences for line drawings similar to the production of others of their own age (going through Best Picture task, to Most Like task, to matching with a real table). In each case the subjects were told that the line drawings were all drawings done by children, and it seems sensible to assume that this would encourage the children to compare them with their own methods of depiction and to judge them in the light of this comparison. It is therefore possible that this aspect of the task becomes less important to the subject the more the task demands emphasise visual realism. Within this argument is the assumption that it is the last of the studies presented here that contains the least number of cues for comparison with the subject's own form of production and the most for accessing how the subject actually 'perceives' a table. The findings of this study indicate a developing sensitivity to visual realism. Both this and earlier studies (Chapters 4 and 5) suggest that this sensitivity develops from about ten years of age. Even so only 25% of adult subjects chose the visually realistic line drawing, and only 53% chose one with a central viewpoint. Taken together the studies in this chapter show that across all ages the vast majority of subjects prefer a line drawing of a table in oblique projection. The quality of the stimuli differed across studies, which might reduce the confidence we have in their comparability. For example, Itskowitz *et al* (1988) found that for children of all ages the inclusion of more features was the primary criterion in a preference task, but that younger children and artistically inclined thirteen year olds also attended to line quality. However, although the line quality of the stimuli differed across the tasks presented here, within each study the quality of the stimuli were similar. Further, the strength of preference for ground line, partial occlusion, and oblique projection across all studies suggests that subjects were indeed judging on form of depiction rather than quality of line.

It would be unwise to assume that preference in viewed depiction necessarily implies that the subject would also prefer to draw in that way if possible. The studies presented in this chapter do indicate that task related variables, such as form of question, affect choice. However, the lack of major task related differences in the strong preference for oblique projection, ground plane, and partial occlusion support the idea that these reflect, albeit in a two dimensional way, aspects of perception and cognitive representation.

The disparity in the findings of the two types of measurement strengthens the argument put forward in Chapter 6 that analysis by projection system and analysis by depth cue cannot be directly equated. They appear to reflect two different clusters of cognitive mechanisms, both involved in the translation of three dimensions to two, and at times co-varied, but having different effects on the final depiction.

In Chapter 6 it was shown that development in the use of depth cues preceded development in the use of forms of projection. The present studies suggest that preference for more complex depth cues is invariant, and, taking the argument further, indicate that all subjects would, if they could, use these depth cues. The preference for oblique projection appears to involve slightly different mechanisms. It could be argued that oblique projection is a default preference, one that the subject falls back on if the task constraints do not emphasise the need for visual realism. As discussed earlier, other researchers have also found a strong preference for oblique projection. It can be argued that oblique projection is the visual description that best preserves the most salient aspects of the table, and hence is the pictorial representation that comes closest to our canonical model of a table. It can be argued further that the majority of subjects would prefer to depict a table in this way, if there are no contradictory task constraints. This is supported by the findings presented in Chapter 4, that the vast majority of older subjects do use this form of projection when drawing a table from imagination. The fact that younger subjects do not use this form of projection, whilst showing no difference in preference for it relative to the older subjects, indicates that, as with the use of depth cues, for some reason they are unable to draw in the way in which they would like to.

This chapter has looked at preference in table drawing, and has found that generally the vast majority of subjects of all ages prefer a table drawing which is in oblique projection and which shows the use of ground plane and partial occlusion. It has been suggested that, given no contrary task constraints, subjects would also prefer to draw in this way. The following two chapters explore further whether this is the case, and, if so, why subjects do not succeed in depicting a table as they would wish to.

CONTENTS OF CHAPTER 8.

Completion of line drawings of tables.

Chapter 8.

Completion of line drawings of tables.

Summary.

It is hypothesised that subject's inability to draw a table in the manner that they have judged looks most like a table, as demonstrated in the previous chapter, might be overcome by giving subjects substantial aid with the production of the line drawing. The study reported here was designed to investigate that hypothesis for various degrees of help and across a range of ages. Subjects were asked to complete a series of 23 line drawings of a table, draw a table of their own, and choose which of the drawings, including their own, was most like a table. Some of the line drawings to be completed were ambiguous, allowing a wide latitude of response, whilst others approximated closely to tables in vertical oblique, oblique or perspective forms of projection. The number of lines required to complete these forms of projection varied.

It was found that the majority of all subjects preferred a table in oblique projection, showing the use of ground plane and partial occlusion, but that subjects tended to complete tables in accordance with their own production despite the degree of help given. This effect was so strong that some subjects deliberately altered the stimulus, rather than adding the one line required to depict a table in oblique projection.

The appendices for this chapter contain an enlarged version of Figure 8:1.

Introduction.

Previous chapters have shown that young children rarely think that the way in which a table is drawn by others of their age actually looks most like a table. The majority of young children prefer a table drawn in oblique projection, but do not draw in this projection. In the previous chapter it was assumed that, when subjects are asked to draw a table, they try to produce the form of depiction that they think looks most like a table. This leads to the conclusion that, generally, young subjects would prefer to draw a table in oblique projection, but for some reason do not.

The situation is obviously more complex than this. As shown in the previous chapter, when young children are asked which depiction they think is the best picture of a table the majority tend to choose those that are slightly in advance of ones produced by others of their age. Even so, a large minority of such subjects still prefer a table in oblique projection. This emphasises the point that, in preference tasks, the nature of the question does have an effect upon the answer, and casts an element of uncertainty upon the assumption that subjects do wish to draw in the manner that they have judged looks most like a table. Many studies, including those presented earlier, have shown that subjects are not necessarily trying to depict visual reality. In order to further the discussion it is necessary to investigate what children are actually trying to depict at any age. Only once this has been assessed can we effectively start to investigate whether or not children do draw what they want to depict, and only then can we ask: if not, why not?

As indicated above, there is no way of guaranteeing that children who say they prefer a table in a particular form of depiction would actually prefer to draw it in this way if only they could. There is similarly no guarantee that children who draw in a particular way do so because they really want to. They might be constrained by a variety of production problems, and might even claim that they want to draw in the way that they actually do because of some form of cognitive dissonance. This study aims to partially overcome these problems by presenting subjects with a series of line drawings to complete.

Firstly, the stimulus is structured to enable subjects to complete the line drawings in different forms of projection, and with varying degrees of constraint. Therefore the less constraint there is the more subjects will be able to use their own form of production. Because various different types of projection are included within the differing levels of constraint subjects preference for forms of projection can be identified. Secondly, because all the different forms of completion are presented on the one sheet subjects will not be experimentally naive, in that they may be able to use the other line drawings as guides, and the close proximity of other forms of projection may accentuate discrimination between the forms of line drawing. The stimuli may therefore help subjects to overcome possible production problems.

The inbuilt lack of experimental naivety is an important aspect of the stimulus. It enables a direct comparison between each subject's production, preference, and completions under these particular conditions, and production and preference can be directly compared with those made by experimentally naive subjects of the same age. In the previous chapter preference was studied in isolation in order to maintain experimental naivety, and so avoid the 'I drew this because I chose it / I chose this because I drew it' syndrome. Here subjects are asked to draw a table of their own, and then to choose the depiction which they think is most like a table. When drawing a table of their own subjects have the opportunity to simply copy the form of projection they prefer from the completions beside it. Further, when subjects are asked to choose the depiction that they think is most like a table they have already partially drawn all 24 tables, with varying degrees of constraint and in different projections. Each of these 24 tables has elements of the subject's own production within it. This means that the tables they produce and choose should enable an accurate analysis to be made of their degree of satisfaction in their own production and, if they are not satisfied with it, the form of table that they would be more satisfied with.

The large number of different conditions means that analysis of the data is very complex. This degree of complexity makes appreciation of the main points somewhat difficult, and so the results are produced in a highly structured way with a brief introduction and conclusion to each section, and appendices are used to contain the more detailed analyses.

Study 8.

Method.

Subjects. Two groups of subjects were used. The first consisted of 210 children aged between 4 and 10 years old, taken from two Primary schools, one in Leyland, Lancashire, and the other on its outskirts. The second consisted of 348 older subjects, from 7 to 64 years of age, taken from a Middle school on the outskirts of Hitchin, Hertfordshire, a Secondary school in Chorley, Lancashire, a Sixth form and Further Education college in Leyland, and Youth clubs and adults' homes in Leyland. An attempt was made to balance ability and sex across all age groups and to ensure that the subject population was roughly equivalent to the general population.

Stimuli. The stimuli were designed to cover a variety of conditions. To aid understanding of this it is necessary to examine the way in which they were organised. A schematic representation of this is given in Figure 8:1. Here it can be seen that the stimuli are grouped according to the type of task required. Stimulus Groups A, B, C, and D, to which a 'variable response is expected' consist of stimuli that, upon correct completion, can elicit a variety of responses. Correct completion of all the remaining stimuli entails the use of the projection system indicated by the stimulus. Stimuli in Groups E, F, and G provide the subject with the table top, whilst stimuli in Groups H and I also provide the table legs.

Whilst the groups are presented in a hierarchical way in this figure, with those providing the least freedom of completion at the bottom, it can be seen that there are cross relationships between them. For example, D8, H4, and I11 only differ by one line. The full stimulus was prepared in two versions, one of which can be seen in Figure 8:2. To enable an examination of possible positional bias, a further check, within stimulus, was introduced by including G21 twice on the second version of the full battery.

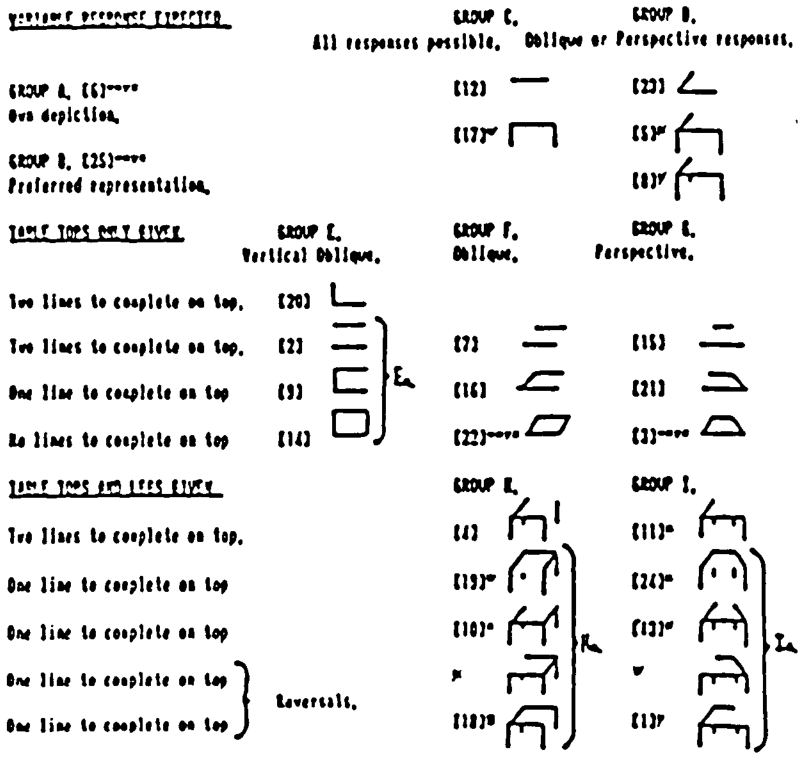


Figure 8:1. *Relationship between the parts of the stimulus used in Study 8:1. See text for details.*

It was felt that the performance of the younger children would be adversely affected if they were given the full range of possible stimuli, and so two different forms of stimuli were constructed. Older subjects were given the full set of stimuli, whilst smaller versions were prepared for the others. A four year overlap in age group between the older and younger subject pools was designed into this study to enable a comparison of the efficacy of the two major groups of stimuli.

Four different sets of stimuli were designed for the younger subjects. Each contained F22 and G3 (to enable a comparison to be made between these sets of stimuli), and three from the rest of the battery, chosen to be balanced across table type and degree of freedom of completion. Components of the four different sets are marked W to Z in Figure 8:1.

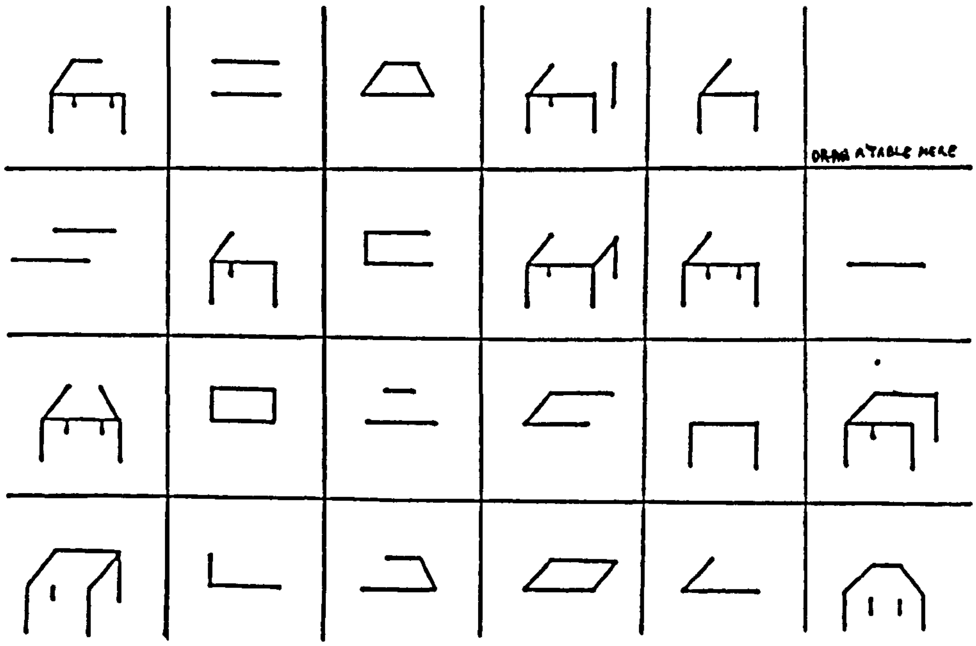


Figure 8:2, An example of the full stimulus used in Study 8:1,

Procedure. The older subjects were given a sheet with one version of the full battery of completion tasks on it. Presentation of the sheets was balanced across age, sex, and ability. Each subject was either seen individually or, for secondary school subjects, within a class and was told 'All these drawings are of tables. Some are drawn in different ways. They all need finishing off. Could you finish them off for me now please?' They were allowed to work at their own pace, and when they had finished they were asked 'Please would you draw a table of your own in the space?' if they had not already done so. They were then asked 'Now, I'd like you put a circle around the drawing that you think looks most like a table? You can circle your own drawing if you want, ... which ever one you think looks most like a table'. The repetition was included to avoid possible bias against circling their own due to a misplaced belief that what an adult gives you must be best. They were then asked to put their age and sex on the back of the sheet.

The younger subjects were given one of the four versions of the reduced battery. Presentation of each version was balanced across age, sex, and ability. Each subject was seen individually, and was given each completion to do on separate, previously prepared sheets. The order of presentation of each separate sheet was balanced across subjects. The task was explained as above. The completions, once done, were placed on the table beside the subject so that the subject was able to see his or her previous completions. Several subjects felt that nothing needed to be done to some of the completions. When this occurred the untouched sheet was left on the table with the others. Subjects were asked to draw a table of their own, using the wording given above, but on a separate sheet, which was also placed on the table. Each subject was then asked to choose, rather than circle, which of the drawings looked most like a table. The choice was recorded once the subject left the room, as was age, sex, and subject number.

Results.

A) PRELIMINARY ANALYSIS..

Raw data is given in Appendix 8:A.

All the drawings were classified according to the system given in Chapter 6, with one exception. In Chapter 6 table top type 9 indicated the use of a semi-circle. A table top of that form was never produced here, but it is used here to indicate drawings where, instead of completing the lines to produce a table top in perspective, subjects extended the oblique line and drew another crossing both ends of the two lines, thus producing an isosceles triangle to depict the table top. Very few subjects produced this form. In the analyses the data for the 'minor' forms of table top are amalgamated with the major forms in accordance with the methods used in Chapter 6. Thus the few responses obtained that had parts of the stimuli completed in this way were amalgamated with the perspective response.

Where there was little freedom in the stimulus the expected form of table top has been indicated at the head of the column, but some subjects altered the stimulus to give alternative forms of table top and table legs. Similarly, some of the younger subjects added lines across the bottom of the legs of the stimuli, clearly defining a ground line or a ground plane. This has been indicated in the raw data by placing a line under the response (for a ground line), and enclosing the response in a box (for a ground plane).

The first concern was to evaluate the extent to which the different forms of stimuli produced equivalent results. A variety of comparisons were made, which are detailed in Appendix 8:B. All comparisons showed little difference in proportions of response, with age, for identical tasks, measured between the two main forms of stimuli given to older and younger subjects, the four groups of stimuli given to younger subjects, the two groups of stimuli given to older subjects, within one stimulus sheet given to older subjects, and across sex. For this reason the data across all these categories were amalgamated and are given in Appendix 8:C.

The next concern was to analyse the responses within each stimulus group. Full detailed analyses for groups C to I are given in Appendix 8:D. Appendix 8:E contains the amalgamated data for each group. In these analyses, and from henceforth in the discussion, each item in the stimulus is referred to as if it were a separate stimulus. This change in nomenclature has been done to streamline the language used in these analyses, and does not indicate that each part of the stimulus was presented separately. Brief summaries of the findings presented in

Appendix 8:D are given below. The analyses for each group are initially reported as individual units. Cross group comparisons will be made later.

B) SUMMARY OF INTRA-GROUP ANALYSES.

Group C.

Group C contains two table types, nos. 12 [—] and 17 [⊓] in Figure 8:1. The main areas of difference between the two stimuli are in the proportions, with age, of the vertical oblique and no ground line responses. Stimulus 17 elicited significantly more vertical oblique and no ground line responses from older children than did Stimulus 12, the straight line. In the same way Stimulus 12 elicited more orthographic and perspective responses in the same subjects than did Stimulus 17. Thus the inclusion of two lines at right angles to the top, which gives an essentially square shape to the stimulus, encourages subjects to draw a square table top and also discourages subjects from using a ground line or ground plane. This effect is evident in subjects between nine and fifteen years of age. It is interesting to speculate that some of the subjects in this age group, who spontaneously produce 'plan' type of tables as identified in Chapters 3 to 6, do so because of the way in which they place the first lines on the paper.

The only table top measure on which no significant differences are evident is that of oblique projection. This reinforces arguments put forward in earlier chapters about the uniqueness of the oblique response. Whilst there are significant differences in response to the two stimuli there are also similarities. The majority of younger subjects use vertical oblique projection, whilst the majority of older subjects use oblique. A

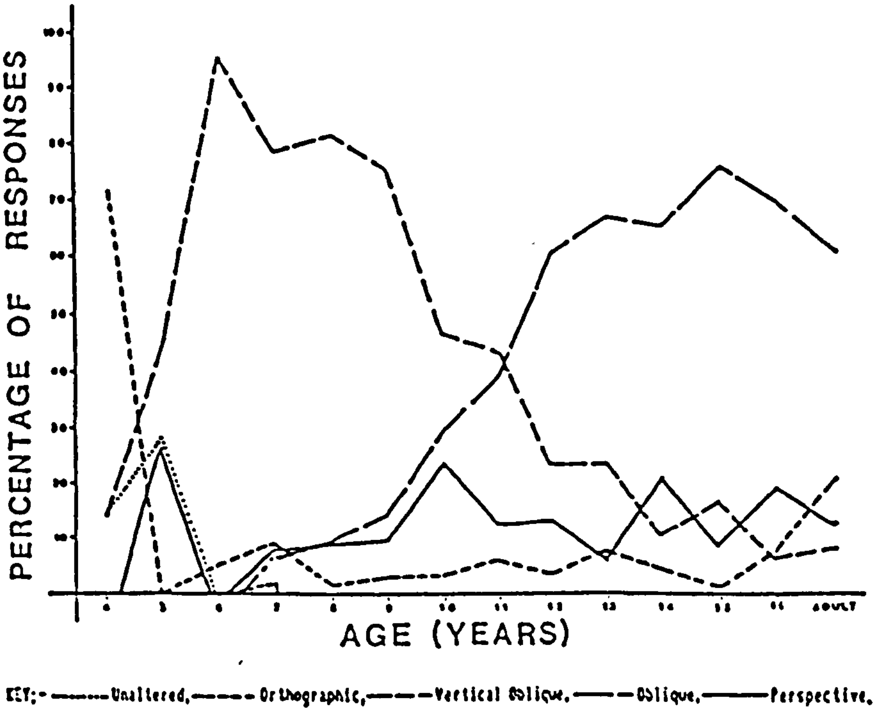


Figure 8:3. *The proportions of subjects using each type of table top on Stimulus Group C.*

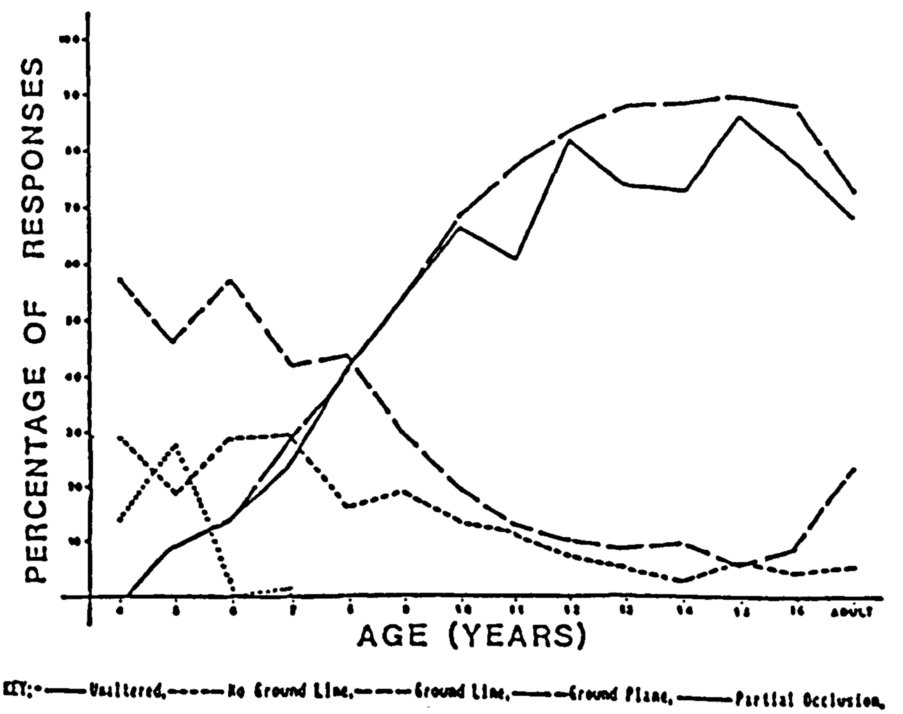


Figure 8:4. *The proportions of subjects using each type of depth cue on Stimulus Group C.*

small, but relatively steady, proportion of subjects use perspective. Subjects show a steadily increasing preference, with age, for the production of ground plane and partial occlusion. Younger subjects prefer no ground line and ground line, and, whilst the strength of this preference declines with age, some subjects at all ages complete the stimuli in this way.

Whilst there are significant differences in response to the two stimuli there are also similarities. The differences will be addressed later when further cross-stimulus comparisons are made, but in order to compare the different stimulus groups it is necessary to examine the amalgamated data for Group C. Figure 8:3 shows that few subjects leave the stimuli unaltered or use orthographic projection. The majority of younger subjects use vertical oblique projection, whilst the majority of older subjects use oblique. A small, but relatively steady, proportion of subjects use perspective.

Figure 8:4 illustrates the way in which depth cues are used in Group C. Subjects show a steadily increasing preference, with age, for the production of ground plane and partial occlusion. Younger subjects prefer no ground line and ground line, and, whilst the strength of this preference declines with age, some subjects at all ages complete the stimuli in this way.

Group D.

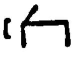
Group D contains three table types, nos. 23 [], 5 [], and 8 [] in Figure 8:1. Stimulus 5 encourages a lower proportion of perspective response from older subjects than do the other stimuli. This is counter-balanced by a higher oblique response, but the difference between the stimuli for the oblique response does not reach significance. The amalgamated responses for stimuli in Group D are illustrated in

Figure 8:5. *The proportions of subjects using each type of table top on Stimulus Group D.*

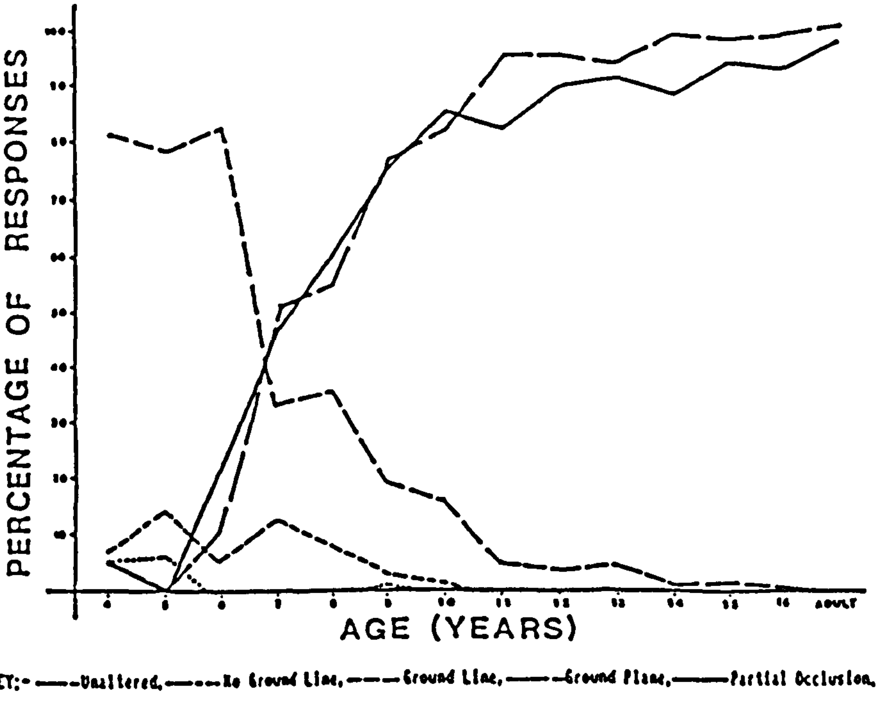


Figure 8:6. *The proportions of subjects using each type of depth cue on Stimulus Group D.*

Figures 8:5 and 8:6. They show that the majority of younger subjects complete the table tops in perspective, but, with age, an increasing number of subjects use oblique projection. The exceptions to this are the four year old subjects, the majority of whom alter the stimulus to provide a table top in vertical oblique projection. A small proportion of subjects between five and nine years of age, and a few fifteen year olds, also make this alteration. The majority of subjects between four and six years old complete the table legs to a ground line, but after this age ground plane and partial occlusion are used.

Group E.

Group E contains four table types. Three of them, nos. 2. [], 9 [], and 14 [] in Figure 8:1, form a subgroup, Ea. The fourth is stimulus 20 []. Tests found significant differences at the $p < 0.05$ level between the Ea subgroup on the no ground line response, attributable to stimulus 2. The cause of these differences is, however, unclear. Similarly, whilst there were significant differences between these three stimuli and stimulus 20 in the perspective response the psychological significance of this is unclear.

The amalgamated data show that the vast majority of all table tops completed in Group E, for all ages of subjects,are in vertical oblique projection, as can be seen in Figure 8:7. Some older subjects altered the stimulus to depict the table top in oblique projection, but the number at each age group doing this was very small. Figure 8:8 shows the way in which the depth cues are drawn on the stimuli in Group E. A steadily increasing proportion of younger children, with age, show a preference for using ground plane and partial occlusion. Correspondingly, a steadily decreasing proportion show a preference for no ground line and ground

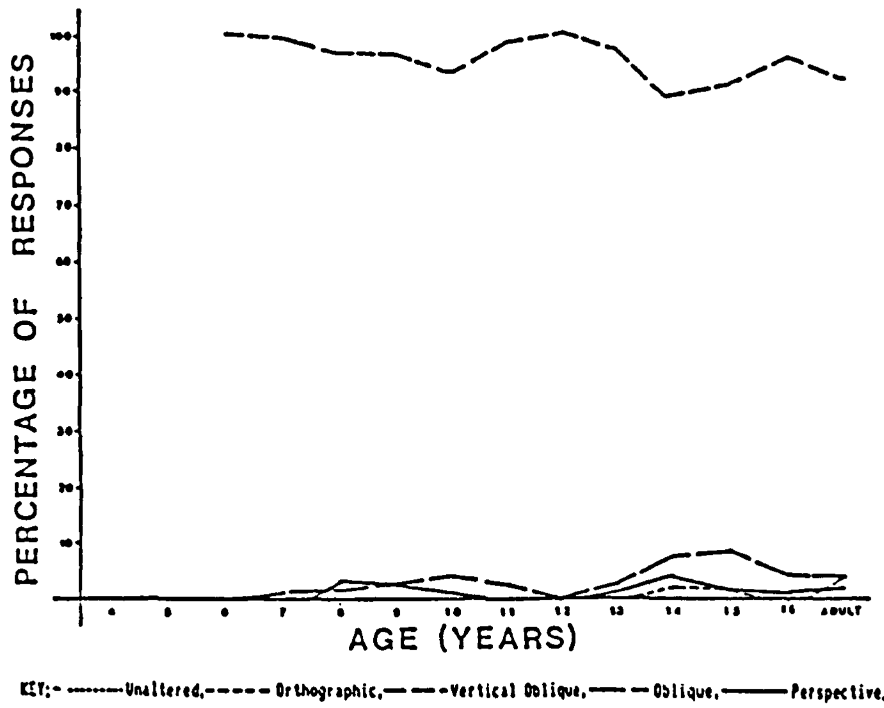


Figure 8:7. *The proportions of subjects using each type of table top on Stimulus Group E.*

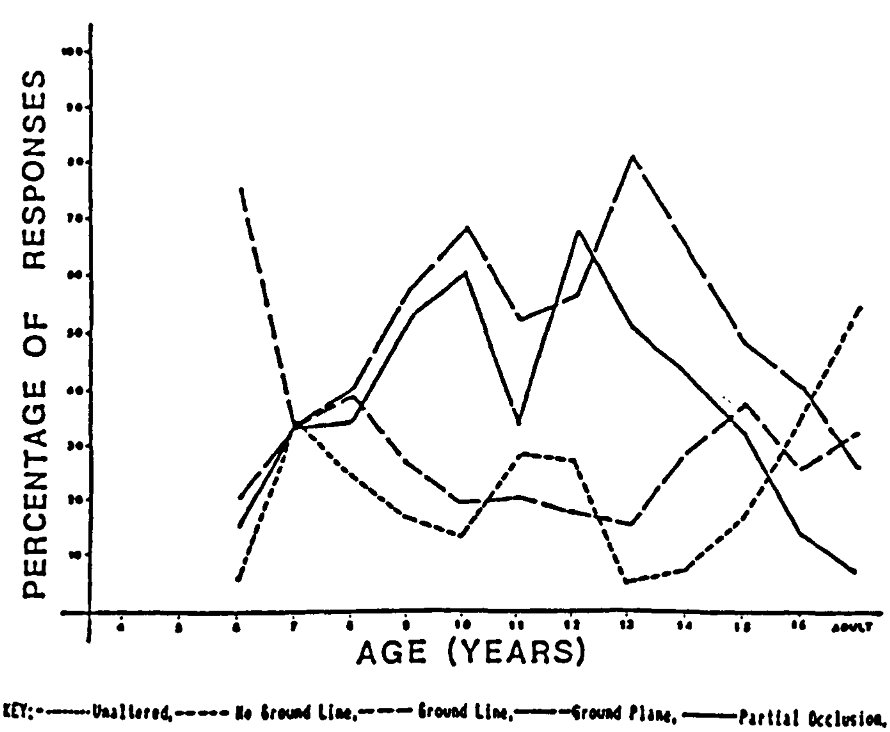


Figure 8:8. *The proportions of subjects using each type of depth cue on Stimulus Group E.*

line. There is, however, a reversal of these trends between ten and thirteen years of age. By adulthood the majority of subjects use no ground line and of the remainder equal numbers of subjects using ground line or ground plane. Decrease in the use of partial occlusion, with age, is even greater than that of ground plane. The no ground line response is further complicated in that it shows a secondary peak between eleven and twelve years of age, reaching approximately 30% at this time. This complex response is elicited by all four stimuli, and indicates an area which might reward further investigation. This will be discussed later.

Group F.

Group F is contains three table types, nos. 7 [ ], 16 [ ], and 22 [ ] in Figure 8:1. The only significant differences found between the stimuli were on the oblique and perspective responses. The proportion of subjects responding in oblique projection on the table top is a function of the number of table top lines given in the stimulus. If there are less lines in the stimulus which encourage such a response then fewer of the younger subjects make that response. Stimulus 22 elicited no perspective response at all, whilst the other two stimuli both elicited a little. However, the main finding is that the majority of all table tops completed in Group F, at all ages, are in oblique projection, as can be seen in Figure 8:9. A minority of subjects between 5 and 10 years old appear to be unhappy with the table top in oblique projection, and alter the stimulus accordingly. The majority of these subjects alter it to form a table top in vertical oblique projection, although between four and ten percent of subjects between six and nine years old alter it to form perspective. Figure 8:10 shows that the proportion of subjects using ground plane and partial occlusion rises steadily from about ten percent

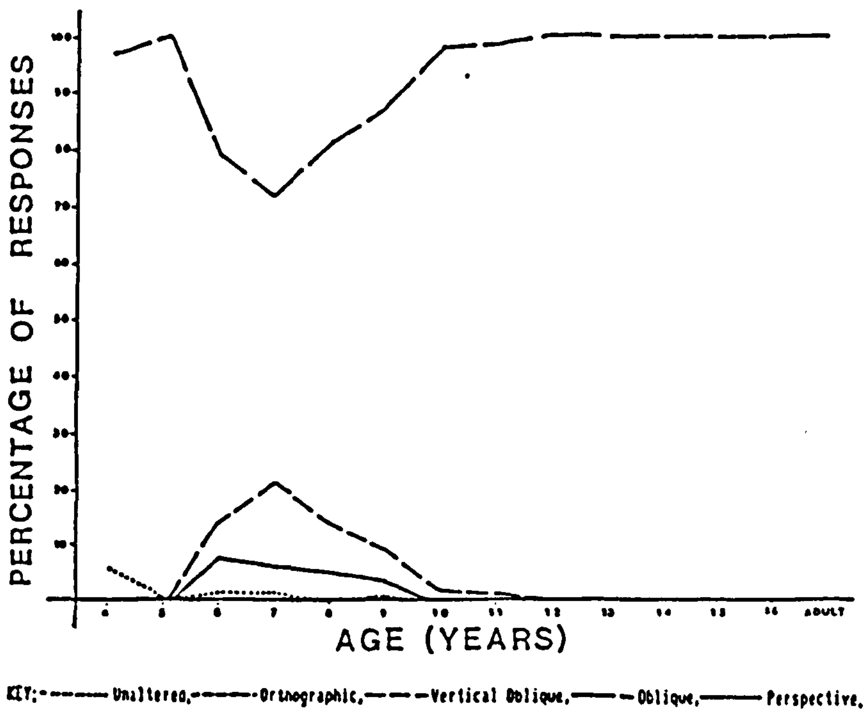


Figure 8:9. *The proportions of subjects using each type of table top on Stimulus Group F.*

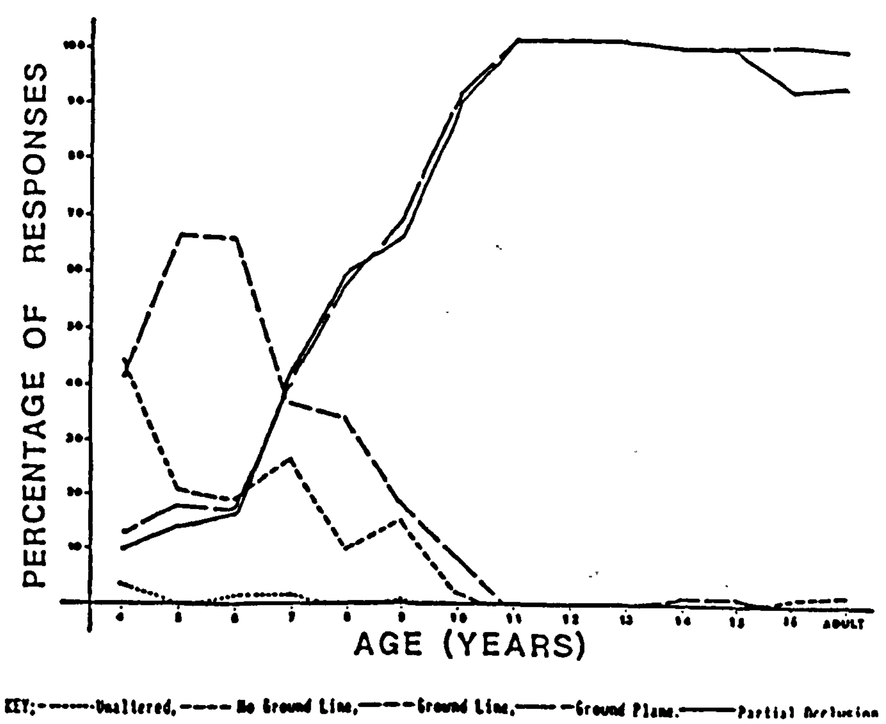
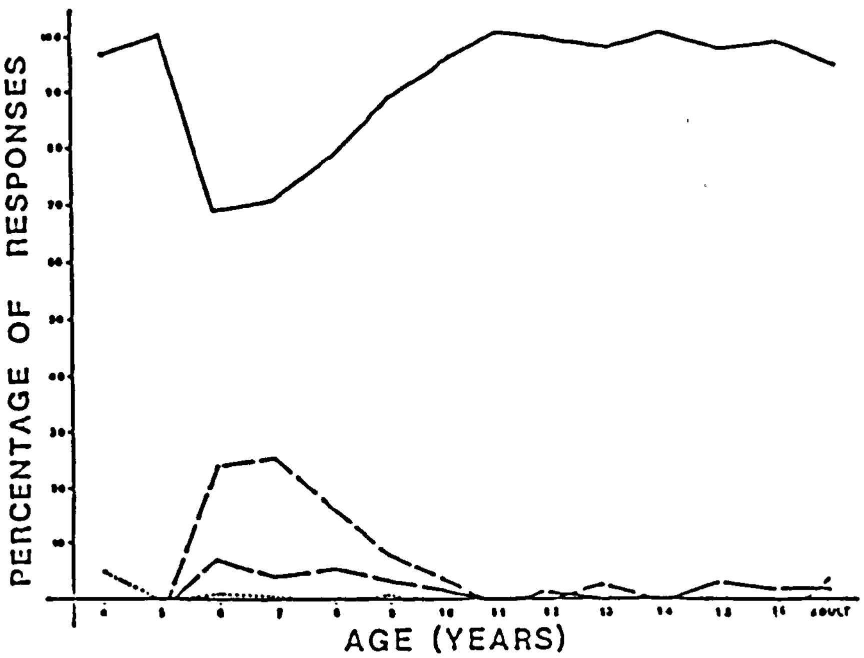


Figure 8:10. *The proportions of subjects using each type of depth cue on Stimulus Group F.*

at four years of age to one hundred percent at eleven. This rise corresponds to a steady decline, with age, in the use of no ground line and ground line, the first being less popular than the second.

Group G.

Group G contains three table types, nos. 15 [], 21 [], and 3 [] in Figure 8:1. The only significant differences between the responses to the stimuli was with respect to perspective. The proportion of subjects responding in perspective on the table top was a function of the number of table top lines given in the stimulus. If there are less lines in the stimulus which encourage such a response then fewer of the younger subjects make that response. It is interesting to note that when the same phenomenon occurs in stimulus group F, on the oblique table tops, it results in significant differences in the perspective response, whilst the reverse is not the case here. This difference will be discussed later. Figure 8:11 shows that the majority of all table tops completed in Group G, at all ages, are in perspective. A minority of subjects between 5 and 10 years old appear unhappy with the table top in perspective and alter the stimulus accordingly. The majority alter it to form a table top in vertical oblique projection, although between two and five percent of subjects between six and nine years old alter it to form oblique projection. Figure 8:12 illustrates that the proportion of subjects using ground plane and partial occlusion rises steadily from about four percent at five years of age to one hundred percent at eleven. This rise corresponds to a steady decline, with age, in the use of ground line. No ground line is used by between eight and fifteen percent of subjects between four and nine years of age.



KEY: ········ Unaltered, — — — — Orthographic, — — — Vertical Oblique, —— —— Oblique, ———— Perspective.

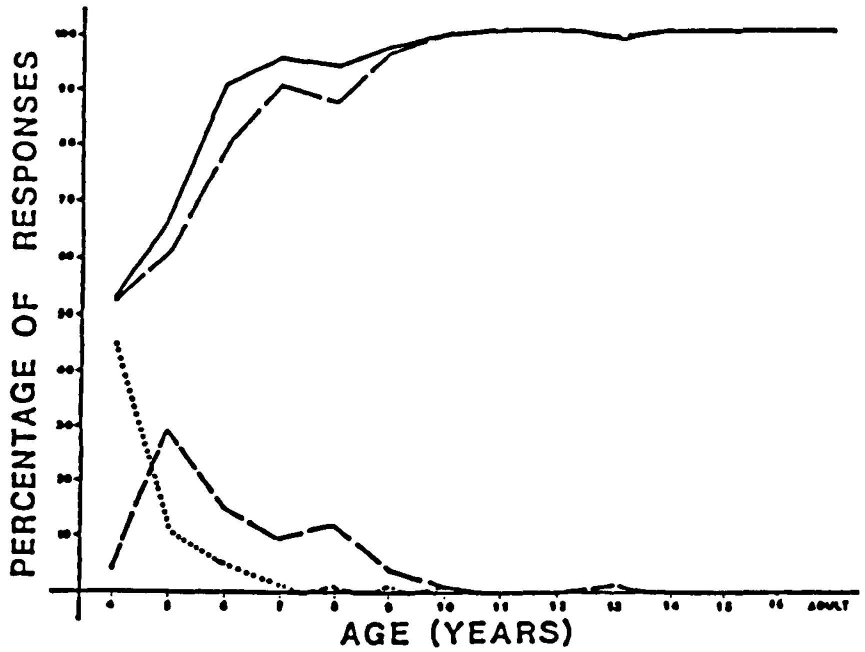
Figure 8:13. *The proportions of subjects using each type of table top on Stimulus Group 6.*

KEY: ——— Unaltered, - - - - No Ground Line. — — — Ground Line, —— —— Ground Plane, ———— Partial Occlusion.

Figure 8:12. *The proportions of subjects using each type of depth cue on Stimulus Group 6.*

KEY:- ——— Unaltered, ————Orthographic,— — —Vertical Oblique,——— —Oblique,———Perspective,

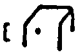
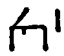
Figure 8:13. *The proportions of subjects using each type of table top on Stimulus Group H.*



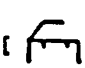
KEY:- ———Unaltered,————No Ground Line,— — —Ground Line,——— —Ground Plane,———Partial Occlusion,

Figure 8:14. *The proportions of subjects using each type of depth cue on Stimulus Group H.*

Group H.

Group H contains four table types. Three of them, nos. 19 [], 10 [], and 18 [] in Figure 8:1, form a subgroup, Ha. The fourth is Stimulus 4 []. A comparison of responses on these stimuli shows that a significantly greater proportion of the younger subjects are able to complete the stimulus correctly when it is the top back line that is missing. The amalgamated data can be seen illustrated in Figures 8:13 and 8:14. They show that the vast majority of all table tops, at all ages, are in oblique projection. However, between five and ten percent of subjects between the ages of four and nine alter the stimulus to depict the table top in vertical oblique projection, rather than adding the single line required to complete the stimulus. A smaller proportion of subjects (3 to 5 percent) aged between seven and nine alter the stimulus to give a table top in perspective. The stimuli in this group give the depth cues of ground plane and partial occlusion, but between four and thirty percent of subjects from four to nine years of age deliberately alter the stimuli, by extending the legs, to give a ground line rather than accept the use of ground plane.

Group I.

Group I contains four table types. Three of them, nos. 1 [], 13 [], and 24 [] in Figure 8:1, form a subgroup Ia. The fourth is stimulus 11 []. The amalgamated data are illustrated in Figures 8:15 and 8:16 and show that for this group the majority of all table tops are completed in perspective for all ages of subject. There are two main exceptions to this. Until subjects are ten years old a small proportion of them in each age group alter the stimulus to produce a table top in vertical oblique projection. Secondly, from about six years of age a small but steady proportion of subjects in each age group alter the stimulus to

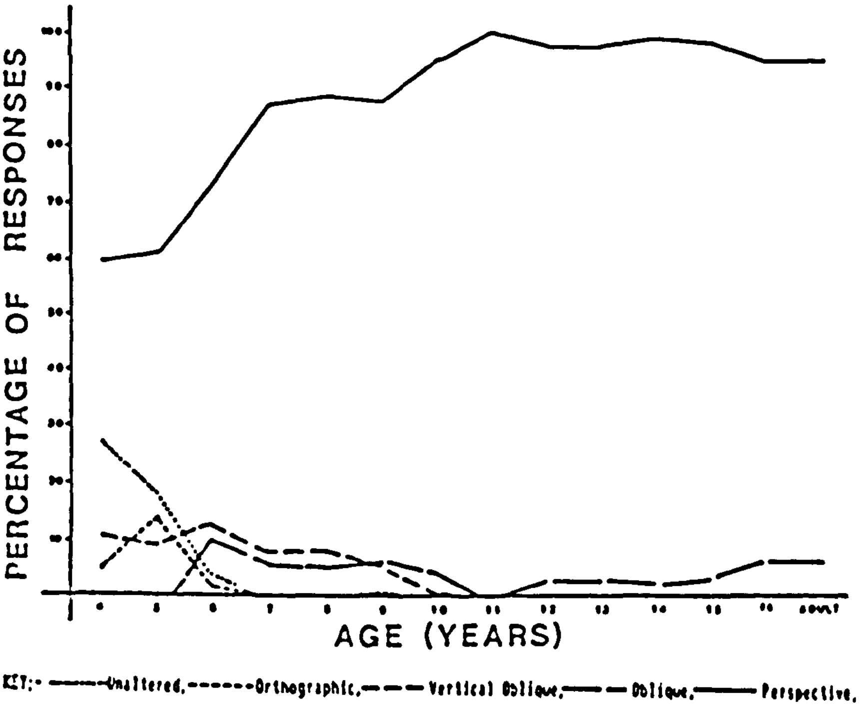


Figure 8:15. *The proportions of subjects using each type of table top on Stimulus Group 1.*

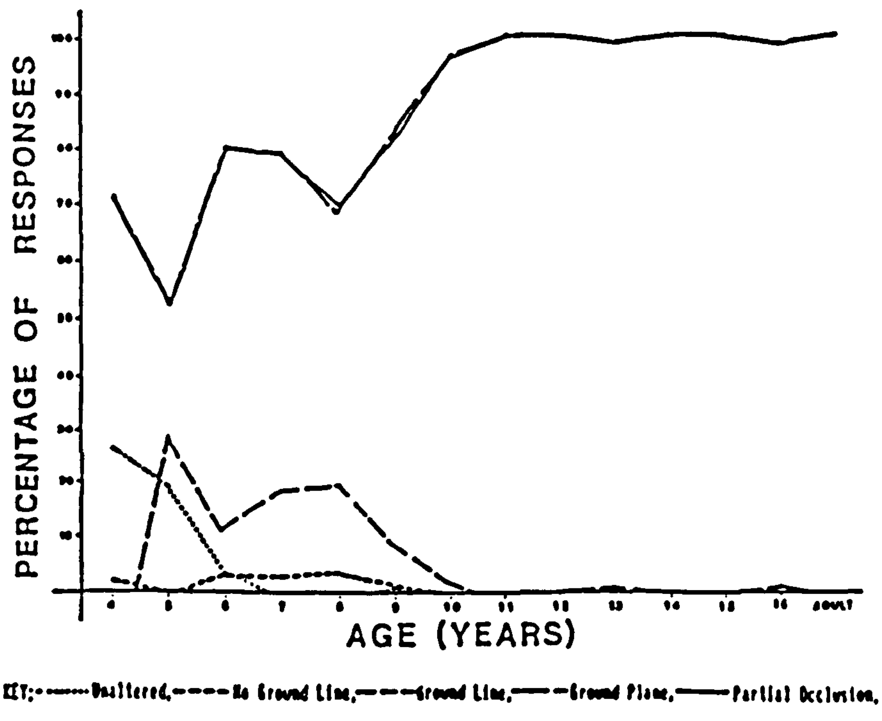


Figure 8:16. *The proportions of subjects using each type of depth cue on Stimulus Group 1.*

give a table top in oblique projection. The stimuli for completion in Group H use the depth cues of ground plane and partial occlusion, but, approximately twenty percent of subjects from five to nine years of age deliberately alter the stimuli, by extending the legs, to give a ground line rather than accept the use of ground plane.

C) SUMMARY OF INTER-GROUP ANALYSES.

This section looks at differences in the amalgamated proportions of response for each group. Firstly, the groups discussed above are examined. Secondly, responses on own production and choice of depiction most like a table (Groups A and B) are compared with each other, with data from Chapters 4 and 7, and with responses on the other groups. The detailed analyses are presented in Appendices 8:F and 8:G, with a summary of the findings presented below.

Ca) Summary of differences between Groups C to I.

This section summarises the findings presented in Appendix 8:F. Comparisons between the stimulus groups were structured by examining the relationships between those groups that offered the least variability first, and then extending this examination to include the other groups. Some of the individual stimuli had been designed to bring out further points, and these are compared where applicable.

Ca1) Differences in proportions of response, with age, between Groups H and I.

The table tops and legs are given in both of these stimulus groups, and the expected response is the addition of one or two lines to complete the table top. All table legs should show ground plane and partial occlusion, and so the only expected variation is in the compulsory completion of the oblique or perspective table top. Significant differences between the two stimulus groups were found in the perspective table top and of ground line responses, but no significant differences were found between the groups on the other responses.

It is worth noting here firstly that there was a much wider range of response than expected, and secondly that no differences were found in the oblique response. Subjects not only changed the stimuli, but did so in a particular way. As expected, very few subjects changed the oblique stimuli to perspective, but, whilst only a small number of subjects changed the perspective stimuli to oblique, the proportions of subjects doing so, at each age, were not significantly different to those responding correctly to the oblique stimuli, as can be seen in Figure 8:17.

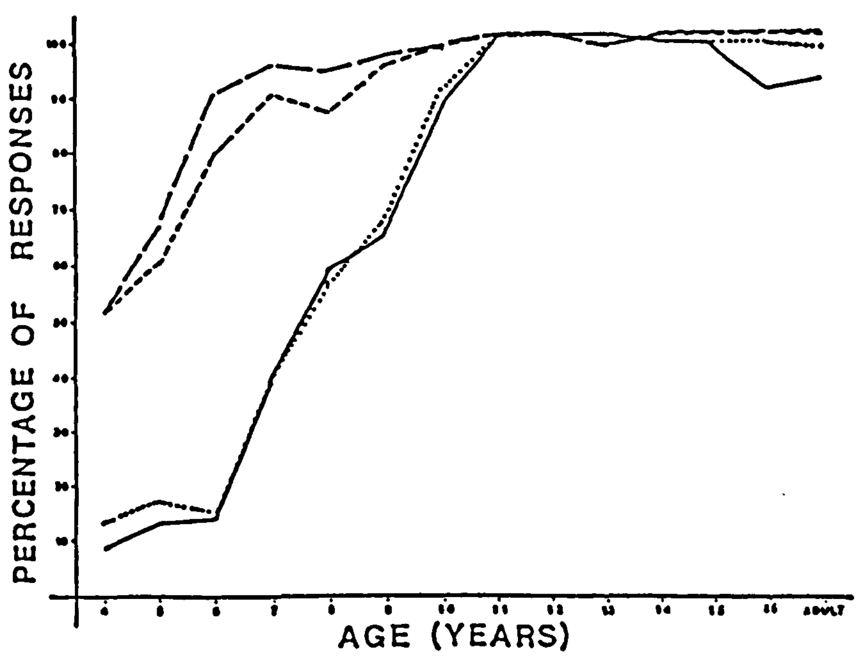
Key:- Oblique .... Stimulus Group H —— Stimulus Group I.
Perspective ------ Stimulus Group H — — Stimulus Group I.

Figure 8:17. *Proportions of oblique and perspective responses to Stimuli Groups H and I.*

The other significant difference found between the two groups is in the ground line response. Whilst some younger subjects in both groups alter the stimulus to provide a ground line response, the majority of such alterations attributable to Stimulus Group H are elicited at an earlier age than are those attributable to Stimulus Group I.

Ca2) Differences in proportions of response, with age, between Groups H and F.

In both of these groups the expected completion is that of a table top in oblique projection, with table legs showing ground plane and partial occlusion. All Group H requires is the addition of one or two lines to complete the table top, as the table legs are already given. The stimuli in Group F only provide the table tops, again requiring two, one, or no lines for correct completion (the stimulus requiring no lines is 22 in Group F). The only expected variation between the two groups is in the



Key:-			
Ground Plane	------- Stimulus Group H,	.... Stimulus Group F,
Partial Occlusion	—·— Stimulus Group H,	——— Stimulus Group F,

Figure 8:18. *Proportions of ground plane and partial occlusion for Stimulus Groups H and F.*

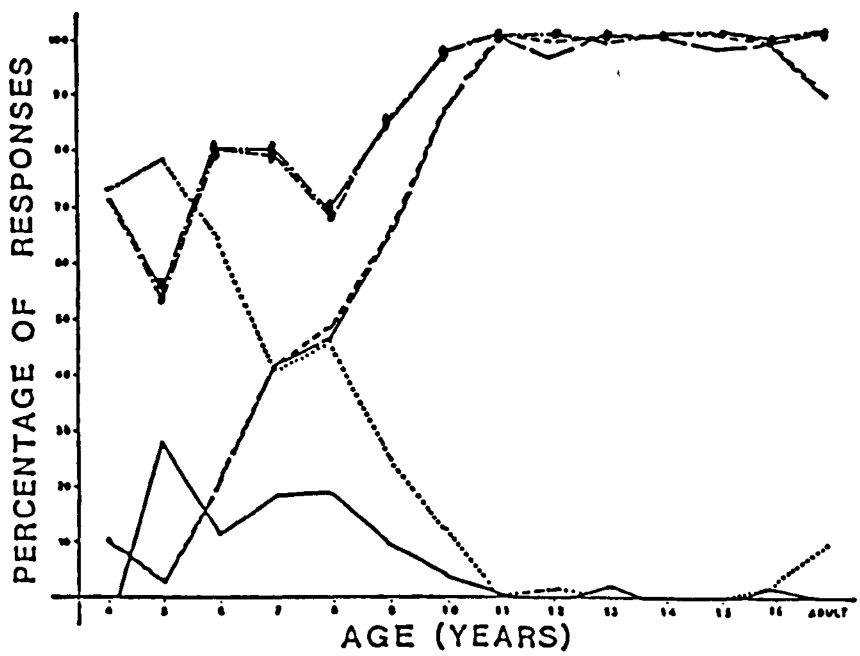
way in which the legs are completed. Many more subjects used no ground line and Ground Line in Group F than in Group H, but tests failed to find any significant differences between the two groups in profiles of the proportions of subjects doing so at each age.

As expected there were major differences between the two groups in the use of ground plane and partial occlusion, and these are illustrated in Figure 8:18. The proportions of young children who deliberately alter the table legs away from ground plane and partial occlusion can also be seen here.

Significant differences found between the two groups in the use of vertical oblique and oblique projection on the table tops is less expected. However, reference to the previous section shows that there were differences in the way in which the table tops were completed within Group F. Stimulus F22 requires no lines to be added for a correct completion, and the majority of the variation found within Group F appears to be attributable to this. The statistical comparisons applied here rely upon the amalgamated responses for both groups, and thus could be affected by a lack of direct comparability between the two groups caused by the inclusion of a completed table top in Group F but not in Group H. Two individual stimuli, one from each group, are directly comparable, namely F16 and H18. Tests found significant differences between these stimuli in the oblique response, but not in the vertical oblique response. From this we can conclude that the inclusion of the table legs results in a greater proportion of the younger children completing the table top in oblique projection.

Ca3) Differences in proportions of response, with age, between Groups I and G.

In both of these groups the expected completion is that of a table top in perspective, with table legs showing ground plane and partial occlusion. All Group I requires is the addition of one or two lines to complete the table top, as the table legs are already given. The stimuli in Group G only provide the table tops, again requiring two, one, or no lines for correct completion (the stimulus requiring no lines is 3 in Group G). The only expected variation between the two groups is in the way in which the legs are completed. Figure 8:19 shows that, as in the previous section, stimuli with the table legs already given encourage many more responses that use ground plane and partial occlusion. Further, a greater



Key:-

Ground Line	·········· Stimulus Group 6	——— Stimulus Group I.
Ground plane	- -•- - Stimulus Group 6	----- Stimulus Group I.
Partial occlusion	—•— Stimulus Group 6	— — — Stimulus Group I.

Figure 8:19. *Proportions of ground line, ground plane and partial occlusion, with age, to Stimuli Groups 6 and I.*

percentage of older children continue to extend the back legs of the stimulus to give a ground line when legs are included in the stimulus. Taken with the findings presented above about the comparison between stimulus groups H and I, this indicates that not only are the table legs deliberately altered to provide a ground line, but that this effect is greater when the table top is in perspective and is elicited from older children than either when the table top is in oblique projection or when no table legs are included in the stimulus.

It is worth noting here that both in this and earlier chapters the use of ground plane has been found to be in advance of the use of partial occlusion. However both Figures 8:18 and 8:19 show that the opposite appears to be the case for stimulus groups H and I. Of the subjects who do decide to alter the legs of the stimuli in these groups, more are concerned with producing a ground line than are concerned with producing no partial occlusion.

The significant differences found between the two groups in the use of vertical oblique projection and perspective on the table tops is of interest. The majority of variance in the perspective response appears to be attributable to the very small number of four and five year old children attempting to alter the table top away from perspective when presented with a table top on its own. The addition of legs appears to encourage alteration of the stimulus by very young children and so, if the statistical analysis is restricted to subjects from seven years of age and older, no significant differences are found between the stimulus groups on the table top responses.

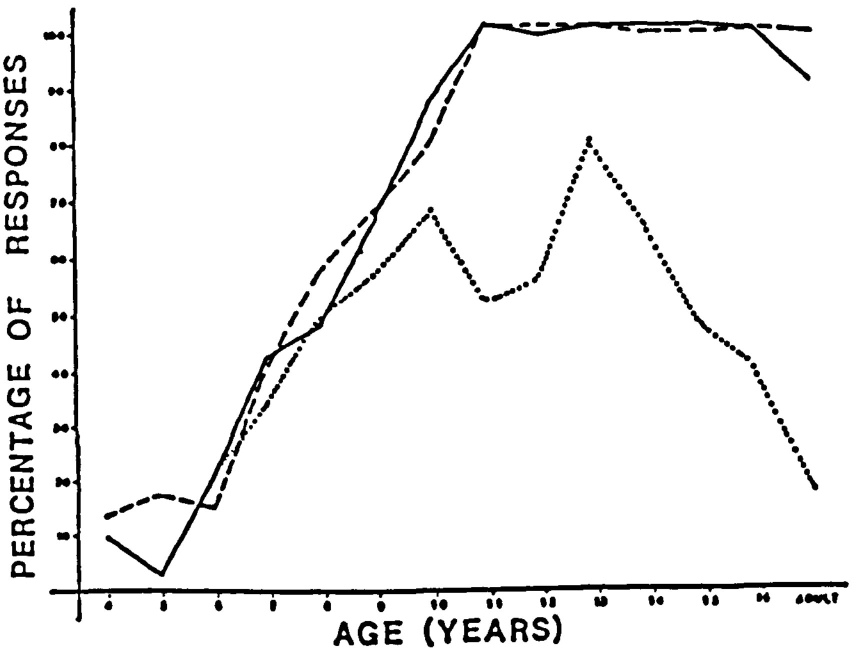
As in the previous section, there were differences in the way in which the table tops were completed within Group G. Stimulus G3 requires no lines to be added for a correct completion, and the majority of the variation found within Group G appears to be attributable to this. The statistical comparisons applied here rely upon the amalgamated responses for both groups, and thus could be affected by a lack of direct-comparability between the two groups caused by the inclusion of a completed table top in Group G but not in Group I. Two individual stimuli, one from each group, are directly comparable, namely G21 and I1. There are significant differences in the oblique response, but none in the vertical oblique and perspective responses. The inclusion of the table legs results in a greater proportion of the younger children completing the table top in oblique projection, even though the table legs are presented in perspective. It is interesting that this effect occurs regardless of the way in which the table top should be completed, and regardless of the way in which the legs are presented. This suggests a link between the presence of the depth cues of ground plane and partial occlusion (regardless of the system of projection used) and the desire to depict a table top in oblique projection.

Ca4) Differences in proportions of response, with age, between Groups E, F, and G.

The stimuli in all three groups only provide the table tops, requiring two, one or no lines for correct completion. The groups vary in the form of table top expected. Group E expects a vertical oblique table top, F an oblique top, and G a top in perspective. Because no table legs are given it is expected that the table legs will be drawn in a similar manner across all groups. The comparison of responses for stimulus groups F and G produces the expected results. The only area of difference between the two is that of the forced response, oblique or perspective table tops respectively. This is attributable to the responses of a small proportion of older subjects who changed the perspective stimuli to form a table top in oblique projection. It is noticeable that no older subjects changed the oblique top to perspective. These findings suggest that older subjects prefer to complete a table top in oblique projection rather than perspective, and show that development in the way in which the table legs are depicted is not dependent upon whether the table top is presented in oblique projection or perspective.

The stimuli in Group E force a vertical oblique response on the table top. This produces a complex effect upon all the measures of response. A small proportion of older subjects alter the stimuli in Group

E away from vertical oblique, thus providing substantially different age profiles to those obtained from groups F and G. However, across these three stimulus groups the opposite effect occurs for oblique projection and perspective. In both groups F and G it is the younger subjects who alter the stimuli away from the expected table top to provide a table top in vertical oblique. Thus, of the small proportion of subjects at any age who alter the stimulus, it is the younger ones who alter it to provide a table top in vertical oblique projection, and the older ones who have been presented with a table top in perspective who alter it to one in oblique projection. However, these effects fail, marginally, to reach statistical significance.



Key:- .... Stimulus Group E ----- Stimulus Group F —— Stimulus Group G.

Figure 8:20. *Proportions in the use of ground plane, with age, on stimulus groups E, F, and G.*

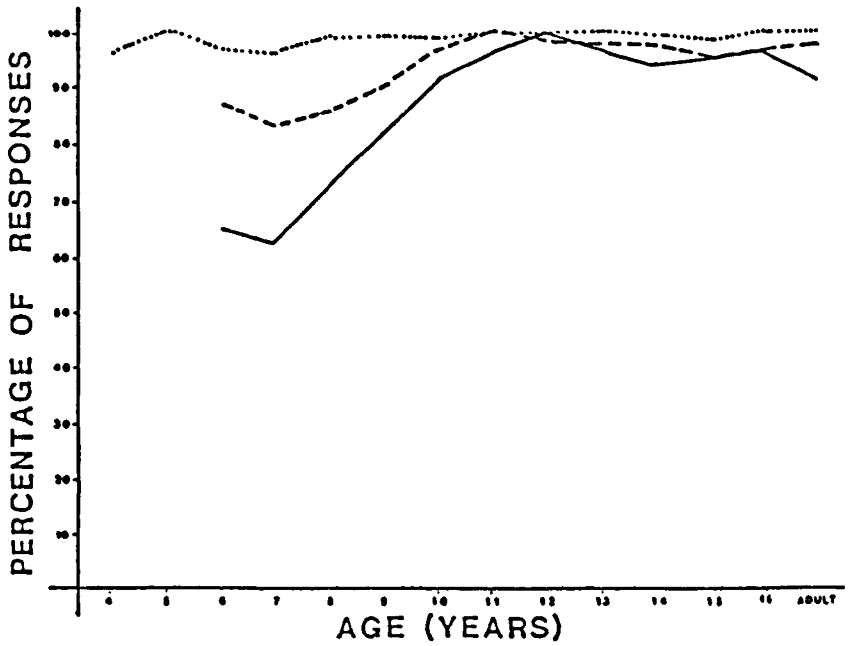
None of the stimuli in groups E, F, and G include table legs. Whilst tests failed to find significant differences between groups F and G in the way in which table legs were completed, Group E was found to be significantly different from the other two groups on all table leg measures, as can be seen in Figure 8:20. Until about ten years of age an increasing proportion, with age, of subjects in all three groups produce ground plane. This increasing use of ground plane continues in both groups F and G, until 100% of subjects are using ground plane and partial occlusion at eleven years of age. It is mirrored by an equivalent decrease in the use of ground line and, to a lesser extent, no ground line. This pattern does not hold in Group E. Here, as was shown in Figure 8:8, between ten and thirteen years of age there is a partial decrease, low plateau, and then slight increase in the use of ground plane, mirrored by an increase and then decrease in the use of no ground line. From thirteen onwards there is a steady decrease, with age, in the use of ground plane, mirrored by an increase in the use of ground line, and no ground line. Furthermore, in Group E the age profile for the use of partial occlusion is significantly different from that of the use of ground plane.

Stimuli in groups E (vertical oblique top) and G (perspective top) all present the subject with a single line at the bottom of the table top from which to draw the legs. If subjects were not sensitive to the form of the table top one would expect similar development in the use of depth cues across all these stimuli, as appears to occur until ten years of age. Such development also occurs across the oblique stimuli, where the line at the bottom of the table top is the one which is nearly always used in the production of ground line. It could be argued that until this age subjects are just reacting to this bottom line. However, the vast majority of older subjects use the bottom line of the perspective table top, but use the bottom and side lines of the oblique top when producing a ground plane. The similarity between the age profiles of the ground plane and partial occlusion responses shows that very few subjects produced ground plane by extending the table legs from the back corners of the table. Thus older subjects do not respond to the vertical oblique stimuli as they do to the perspective stimuli. The significant difference between the age profiles of ground plane and partial occlusion show that many of the subjects produce ground plane by extending the legs from the back corners of the table top, whilst an increasing proportion, with age, of other subjects produce either a plan view of a table (no ground line) or extend all the legs to a ground line. These subjects might be responding to figural biases caused by the square shape of the stimulus, but the lack of difference between the responses to the perspective and oblique stimuli suggests that older subjects respond in this manner because they are attempting to match the table legs to the way in which the top is drawn.

These findings reinforce earlier conclusions that development in the use of depth cues appears to be independent of the form of projection used in the depiction, and that subjects appear to become sensitive to the nature of their depiction at about ten years of age.

C.5) The effect that the number of lines given for completion in Groups E, F, and G has upon correctness of response.

For this analysis the stimuli were grouped according to the number of lines required for completion of the table top. Stimuli E2, F7, and G15 all required two lines for completion, and so responses for these stimuli were amalgamated. Similarly, responses for stimuli E9, F16, and G21 were amalgamated to form the one line for completion group, and E14, F22, and G3 formed the no lines for completion group. Whilst the number of lines for completion has no statistically significant effect it would appear that, to a certain extent, the more lines that require completion the more errors the younger children make, as can be seen in Figure 8:21.



Key:- ·········· No lines required ----- One line required —— Two lines required.

Figure 8:21. *Proportions of correct response, with age, in relation to the number of lines required for completion of the table top.*

Ca6) Differences in proportions of response, with age, between Groups C, and D.

None of the stimuli in these groups were intended to elicit only one form of response. The stimuli in Group C allow any form of response on either the table top or the table legs, and the stimuli in Group D are designed to encourage either perspective or oblique responses on the table top and on the majority of table leg responses. Stimulus Group D does not allow an orthographic response and only a very few subjects deliberately altered the stimulus to produce this. Stimuli in group C encouraged 70% of the four year olds to respond orthographically, and produced a low but steady response across the remaining age groups. The oblique responses in both stimulus groups increase steadily with age, and are significantly correlated, unlike the vertical oblique and perspective responses. Figure 8:22 shows that the majority of younger children respond in perspective to stimuli in Group D (where they are provided with an oblique line upon which to construct their drawing), but respond in vertical oblique to stimuli in Group C (where only the front line of the table is provided). As with the oblique responses, the Group D perspective response and the Group C vertical oblique response are also significantly correlated.

Key:- Stimulus Group C ········ Vertical oblique — — Perspective.
Stimulus Group D - - - - Vertical oblique ——— Perspective.

Figure 8:22. *Vertical oblique and perspective responses on stimulus groups C and D.*

The stimuli in Group D provided subjects with complete freedom to complete them in either oblique projection or perspective. If the two were conceptually equivalent one would expect them to be used in equal proportions at each age group, but this did not occur. Whilst the younger subjects preferred to use perspective, the older subjects preferred to use oblique projection. It appears, to a certain degree, that under these conditions the younger subjects use vertical oblique projection and perspective equivalently, and that the use of these two is task dependent, but that the use of oblique projection develops with age independently of the task.

There was very little difference between the two stimulus groups in the development of use of ground plane and partial occlusion. Relative to the stimuli in group D, the stimuli in Group C encourage a larger ground line response and a smaller no ground line response from the younger subjects. This effect does not appear to be related to the inclusion of the shortened table leg in stimulus D8. The only other difference between these stimulus groups is the inclusion of the oblique line indicating the side of a table top, and thus it must be presumed that it is the inclusion of this line that causes the difference. To summarise, development in the use of ground plane and partial occlusion appears not to be task dependent, but inclusion of a line that prevents the drawing of the table top in vertical oblique projection also significantly reduces the number of no ground line responses and increases the number of ground line responses.

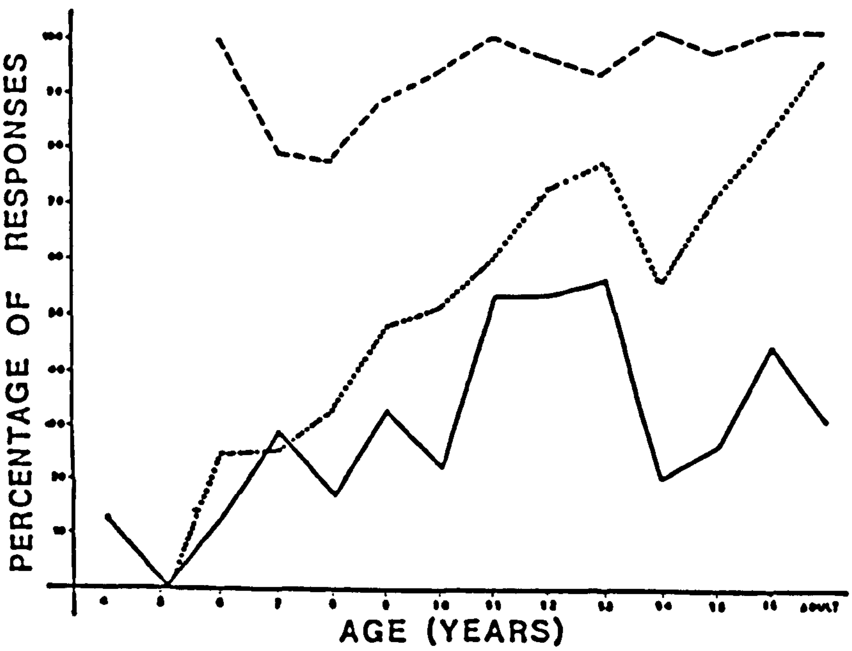
Ca7) A comparison of the proportions of response with age between stimulus group C and groups D, and E, F, and G.

The stimuli in Group C were designed to allow any form of response on the table top, those in Group D to allow either oblique or perspective responses on the table top, and Groups E, F, and G were designed to elicit vertical oblique, oblique, and perspective responses, respectively. All these groups allowed any form of response on the table legs. Earlier, a large difference was found between the way in which depth cues were used in response to stimuli in Group E as opposed to Groups F and G. The results presented here extend this finding. Development in the use of depth cues, and in particular those of ground plane and partial occlusion, appears to be similar across all the stimuli in groups C, D, F, and G. This form of development is not related to whether or not there is an oblique line on the table top, nor to the inclusion of some table legs in the stimulus, either extended from the front or implicitly from the back of the table. The aspect of the stimuli in Group E that appears to be the prime cause of eliciting an unusual use of depth cues (as shown in Figure 8:8) appears to be the forcing of older subjects into the use of vertical oblique projection on the table top.

To conclude, the main finding from these comparisons supports earlier findings that the stimuli in Group E elicit unusual use of depth cues, and extends these findings to suggest that it is the presentation of the vertical oblique table top, rather than any other aspect of the stimuli, that causes this.

C8) The effect of the position of one table leg in stimuli D8, H4, and I11.

Stimuli D8 [ ], H4 [ ], and I11 [ ] were designed to vary only in the position of one table leg. Stimulus D8 could be completed correctly either in oblique projection or perspective, whereas the position of the additional table leg means that H4 should be completed in oblique projection and I11 should be completed in perspective.

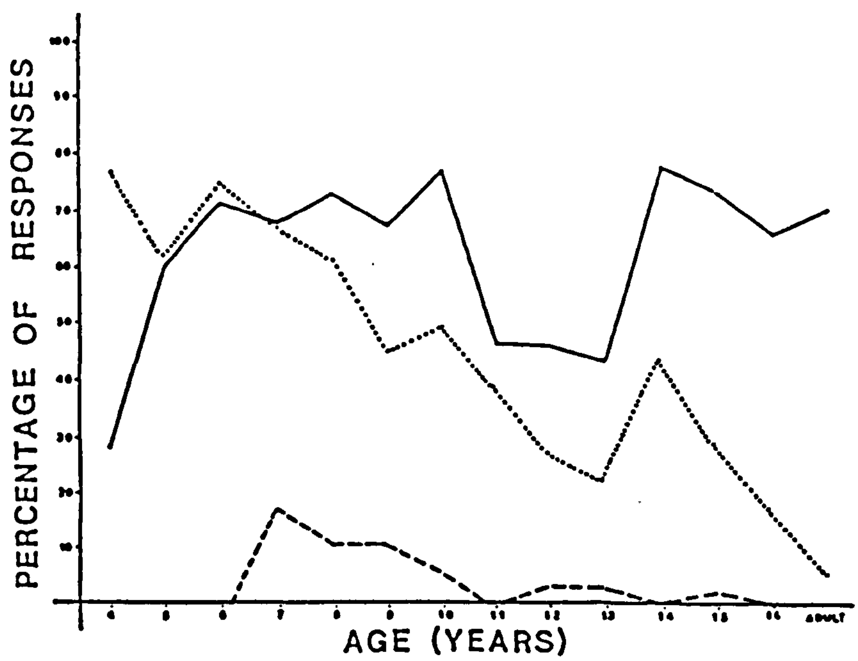


Key:- .... Stimulus D8 [ ] ---- Stimulus H4 [ ] —— Stimulus I11 [ ].

Figure 8:23. *Proportions of oblique response, with age, on stimuli D8, H4, and I11.*

These findings support those presented earlier that development in the use of depth cues is generally stable across stimuli. The significant differences found on the oblique and perspective responses are illustrated in Figures 8:23 and 8:24 respectively. Figure 8:23 illustrates that oblique projection is the preferred response, not only in stimulus D8 where either oblique or perspective could be used, but also, for subjects between eleven and thirteen years of age, on stimulus I11 where a perspective response was expected.

Figure 8:24 illustrates that not only is the perspective response comparatively lower than the oblique response for all three stimuli, but that very few subjects make erroneous perspective responses on stimulus H4, where an oblique response is expected.



Key:- ········ Stimulus D8 [ ] ---- Stimulus H4 [ ] —— Stimulus I11 [ ].

Figure 8:24. *Proportions of perspective response, with age, on stimuli D8, H4, and I11.*

Cb) Summary of differences between all Groups and data from Chapters 4 and 7.

This section summarises the findings presented in Appendix 8:G. Comparisons between the groups were structured by firstly examining the relationships between Groups A and B. Secondly, data for these groups were compared with some of those presented in Chapters 4 and 7, and finally this examination was extended to include the other groups.

Cb1) Summary of differences between Groups A and B.

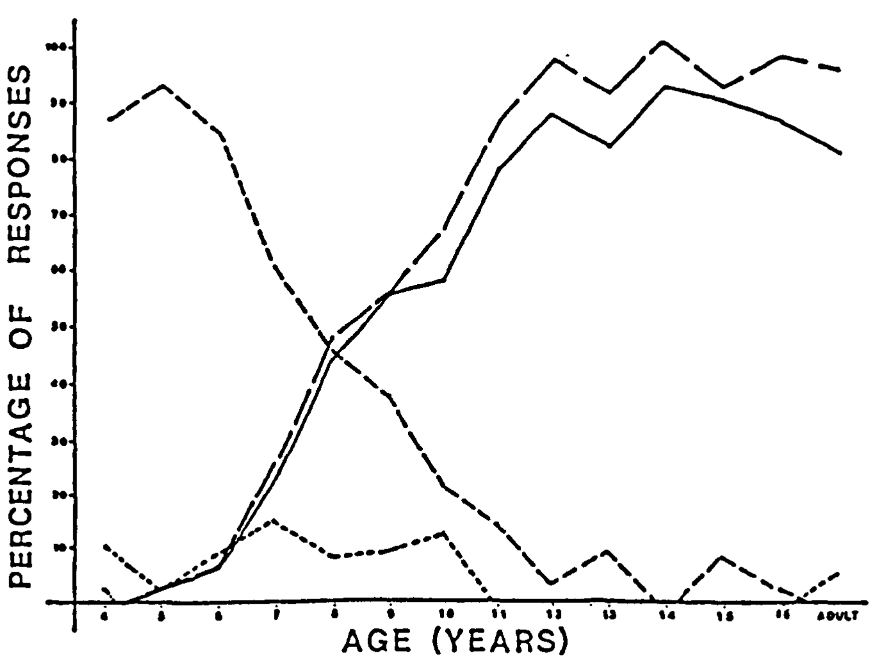
All subjects were asked to both draw a table of their own (Group A, stimulus 6) and to choose from all the representations of a table the one which they thought looked most like a table (Group B, stimulus 25). This design has several aspects worth re-emphasising.

Firstly, when drawing their own table subjects had many depictions of tables, represented in various forms of projection, directly in front of them. Thus, although they were asked to draw their own table they were at perfect liberty to make an accurate copy of any of those that were on the sheet in front of them.

Secondly, when subjects were asked to choose the representation that looked most like a table they were at perfect liberty to choose their own drawing. This design minimises the possibility that subjects might not wish to choose their own depiction because of feelings of inferiority about their own production in relation to the other neatly printed stimuli. Subjects had added lines of their own to all the stimuli, and so whichever they chose had some aspect of their own work in it. This does create a further problem in that some of the younger subjects altered all of the stimuli, thus limiting the amount of choice available to them.

KEY:- ———Unaltered,- - - - Orthographic,— — —Vertical Oblique,—— ——Oblique,———Perspective.

Figure 8:25. *The proportions of subjects using each type of table top on Stimulus A6.*



KEY:- ———Unaltered,- - - - No Ground Line,— — —Ground Line,—— ——Ground Plane,———Partial Occlusion.

Figure 8:26. *The proportions of subjects using each type of depth cue on Stimulus A6.*

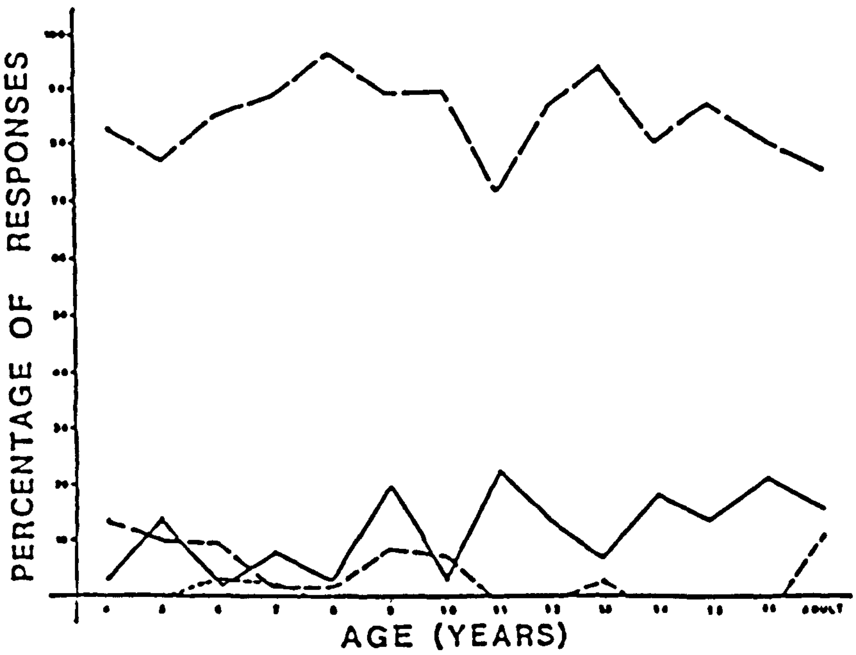


Figure 8:27. *The proportions of subjects using each type of table top on Stimulus B25.*

Figure 8:28. *The proportions of subjects using each type of depth cue on Stimulus B25.*

The design allows a direct comparison to be made between the manner in which each subject draws a table and the form of representation that the subject thinks actually looks most like a table.

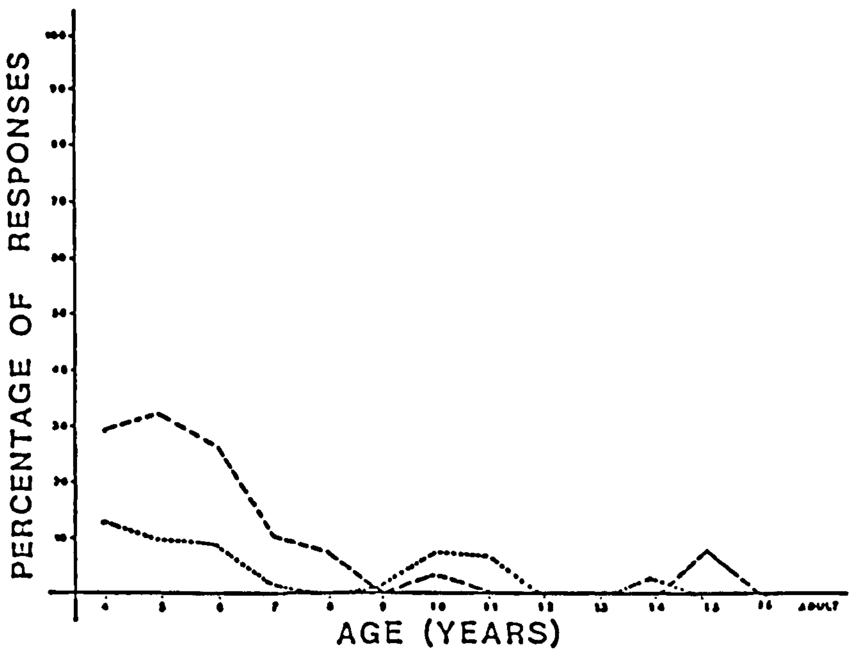
Figures 8:25 to 8:28 show the proportions of responses, with age, on the two stimuli. Significant differences were found between the two stimuli groups for all measures, apart from orthographic projection. In the subjects' own drawings there is clear development in the use of oblique projection, ground plane, and partial occlusion, whereas this is not the case in the subjects' choices. These three attributes are preferred by the vast majority of subjects at all ages, and show no development. It could be argued that marginal development in preference for ground plane and partial occlusion is apparent in the responses of the very young subjects, but, as discussed above, many of these very young children altered the stimuli to show a ground line and no partial occlusion, thus constraining their choice.

A direct comparison between each subject's own production and their choice shows that very few subjects, at any age, chose what they themselves had drawn. A larger number of subjects chose depictions with table tops that were similar to their own, without choosing their own drawing. Nearly all subjects who drew a table top in oblique projection also chose one in this projection. The majority of younger subjects drew table tops in orthographic or vertical oblique projection, yet few chose them as representations most like a table. However, of those who did choose them, the majority also drew a table top in that manner (approximately ten percent of subjects between the ages of four and six, and between nine and ten). This provides some support for the suggestion that some children do prefer their own form of depiction. The perspective response is more confused. It would appear, at first sight, that a small proportion of subjects at most ages both choose and prefer a table top in perspective, but this is not the case. The majority of these subjects either draw a table top in perspective but do not choose it or choose one in perspective but do not draw it.

Cb2) Summary of differences between Groups A and B, and data presented in Chapters 4 and 7.

Because of the design of this study it could be argued that these results have no real compatibility with those given in earlier chapters. This difficulty was examined by looking at the proportions of response, with age, both on type of table top and type of depth cue produced, across group A, and group B, the Imagination responses from Chapter 4, and the Choice of depiction Most Like a table from the previous chapter. Significant differences were found in the vertical oblique and no ground line responses for Choice of depiction, and for the orthographic, perspective, no ground line, and ground line responses for drawing the table, but tests failed to find any other significant differences.

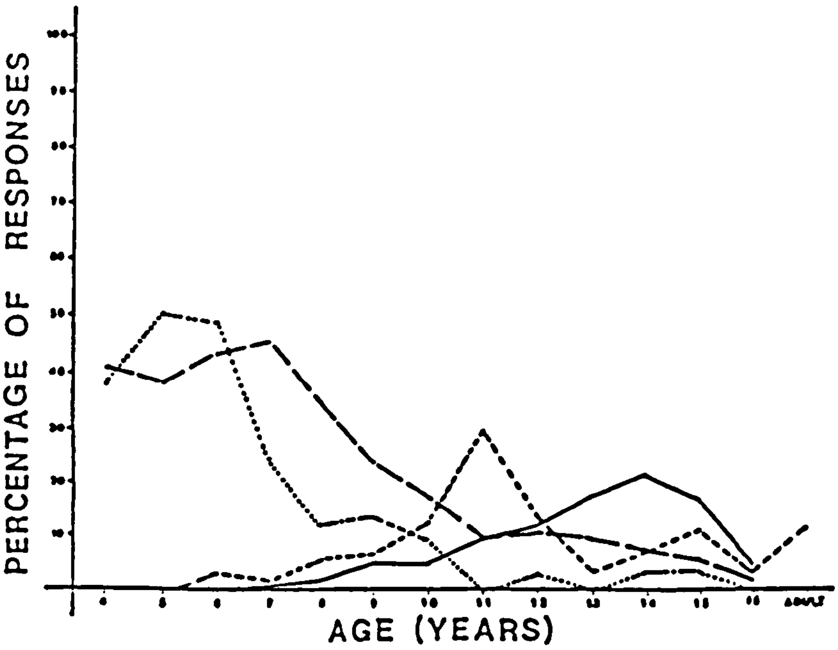
There are very small differences between the choice stimulus (B25) presented here and the choice of projection system other subjects made when they were asked which depiction they thought looked most like a table. There are two measures on which there were significant differences. The number of subjects using a no ground line response were very small in both cases, hence severely limiting the psychological significance of the differences found. The number of responses on the vertical oblique measure were larger, and, as Figure 8:29 illustrates, a larger proportion of subjects between the ages of four and nine make this response when presented with fully completed stimuli (see previous chapter) than when asked to choose from stimuli which they have to complete. However, this effect is reversed for subjects between the ages of nine and eleven. These findings, taken in conjunction with those discussed in the section above about the relationship in the vertical oblique responses between the subject's own production and the subject's choice, strengthens the point that the choice of vertical oblique as the depiction most like a table may well imply different, age related, reasons for this choice.



Key: ·········· Stimulus B25 (choice) -----Most Like condition, Chapter 7.

Figure 8:29. *The proportions of subjects, with age, choosing a table top in vertical oblique projection as the one which looks most like a table when presented with stimuli they have completed (B25) or when presented with ready prepared stimuli (Chapter 7).*

A larger number of significant differences were found between the responses to Stimulus A6 (own production, done with examples of different ways of depicting tables in front of the subjects and available for copying), and the drawing of a table from imagination (Chapter 4, done with no outside aid). Figure 8:30 shows that more of the older subjects use orthographic projection, and fewer of the younger subjects use perspective, on the table tops when they are drawing unaided. Figure 8:31 shows that more of the younger subjects use no ground line, and more of the older subjects use ground line when they are drawing unaided. Therefore, having



Key:-	Stimulus A6 (own)	Imagination, Chapter 4.
Orthographic	....	— —
Perspective	------	———

Figure 8:30. *The proportions of subjects, with age, using orthographic projection and perspective on Stimulus A6 and when drawing a table from imagination.*

Key:-	Stimulus A6 (own)	Imagination, Chapter 4.
No Ground Line	....	— —
Ground Line	-----	———

Figure 8:31. *The proportions of subjects, with age, using no ground line and ground line on Stimulus A6 and when drawing a table from imagination.*

depictions of tables available for copying appears to encourage, partially, the production of the forms of response used by older subjects. This effect is not universal, because the development of oblique projection, ground plane and partial occlusion remains unaffected by the difference in the tasks.

Cb3) Summary of differences between Groups A and B, and Groups C to I.

A comparison was made between the subject's choice of depiction (Stimulus B25, the depiction that they thought looked most like a table) and the responses made on stimulus groups C to I. Tests found significant differences in the majority of the comparisons, only failing to find significant differences on the ground plane and partial occlusion measures when B25 was compared with groups H and I.

A comparison was also made between the subject's depiction (Stimulus A6) and the responses made on stimulus groups C to I. Tests found significant differences in the majority of the comparisons, only failing to find significant differences on the oblique, ground plane and partial occlusion measures when A6 was compared with stimulus group C, and on the ground line and partial occlusion measures when A6 was compared with group G.

Figures 8:32 to 8:39 present these findings in a slightly more user friendly, if rather garish, manner. These figures are complicated and summarise most of the information given in Chapter 8 and the associated appendices. They are included here to give a clear overview of the developmental trends within the data. Each stimulus group is given a particular type of line, and these lines are used consistently in these figures:-

Group A ——— Group B — — Group C ———

Group D — — Group E ——— Group F — —

Group G ----- Group H ——— Group I — —

Figure 8:32 shows that there were very few orthographic responses to any of the stimuli, apart from Stimulus A6, when subjects were asked to draw their own table.

Figure 8:33, looking at the vertical oblique response, shows that Group E stimuli encourage a high vertical oblique response at all ages, but that Group C stimuli elicit a higher vertical oblique response than is produced in Group A (subject's own drawing). None of the remaining groups encourage a high response, as subjects had to deliberately alter the stimuli to produce one, although Groups G and F show a peak in vertical oblique response between six and eight years of age.

Stimulus groups F and H, as might be expected, elicit a high oblique response at all ages, as does Group B, the subject's choice of depiction most like a table. This can be seen in Figure 8:34. Development in the subject's own production of oblique projection is closely correlated with development in the use of oblique on stimuli in Groups C and D. These were classed as variable groups, and so subjects were equally able to use perspective but did not do so. A small number of subjects from six years of age upwards deliberately altered the other stimuli to provide an oblique response.

Stimulus Groups G and I elicit a high perspective response at all ages, as can be seen in Figure 8:35. Similarly, stimuli in Group D elicit a high perspective response, but only from the younger subjects. It would appear that as subjects develop the ability to use oblique projection they choose to use this form of depiction on the table top rather than perspective. Stimulus Groups A, B, and C all elicit a low perspective

Figure 8:32. *The use of orthographic projection in each stimulus group.*

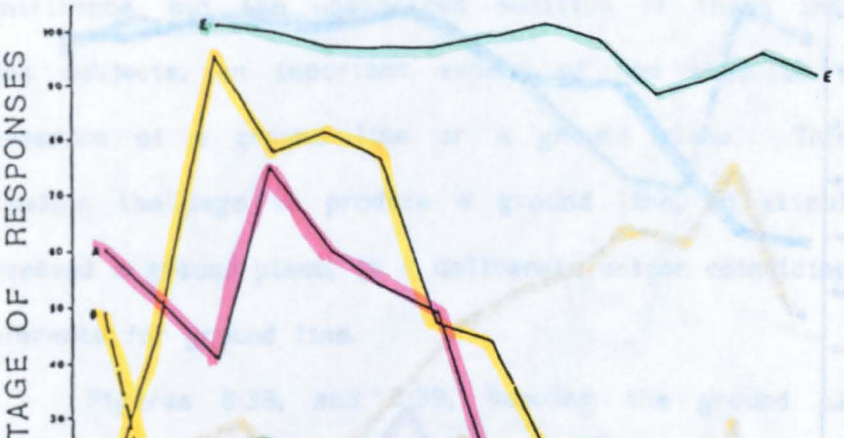


Figure 8:33. *The use of vertical oblique projection in each stimulus group.*

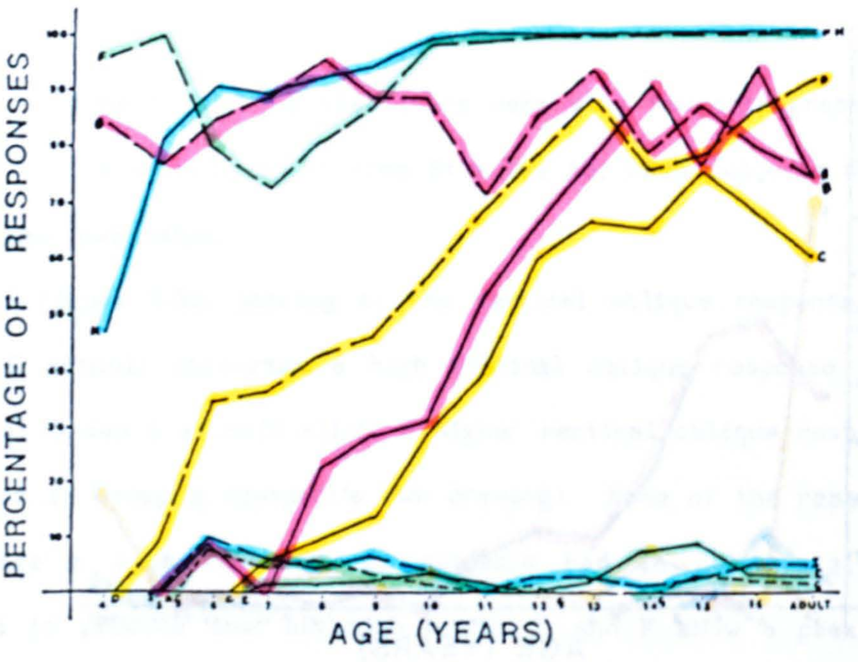


Figure 8:34. *The use of oblique projection in each stimulus group.*

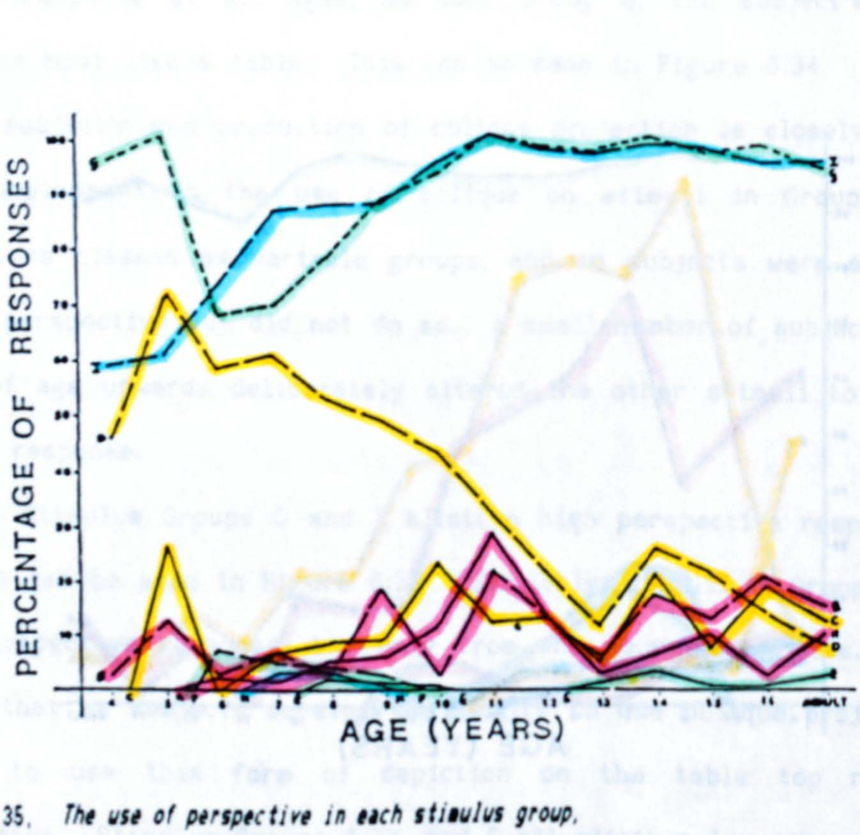


Figure 8:35. *The use of perspective in each stimulus group.*

response from most age groups, but the remaining stimuli encourage hardly any perspective response at all.

Figure 8:36 shows that stimuli in Group E encourage the highest no ground line response, particularly from the older subjects. Stimuli in Group C encourage a small but steady no ground line response across all ages, whilst the remaining stimuli only encourage a no ground line response from the younger subjects. Very few subjects at any age show a preference for no ground line.

The picture is slightly different for the ground line response, as can be seen in Figure 8:37. Here the majority of the stimuli encourage a high ground line response from the younger subjects. The strength of this response declines steadily from about six to twelve years of age. Stimuli in Groups H and I do not allow a ground line response, yet between ten and thirty percent of subjects from five to nine years of age alter the stimulus to provide such a response. Some of the younger subjects drew ground lines or ground planes onto the stimuli, as can be seen in Appendix 8:A. The numbers involved are too small to carry much psychological significance, but the unexpected addition of these indicates that, for these subjects, an important aspect of the stimulus is its perceived possession of a ground line or a ground plane. This indicates that extending the legs to produce a ground line, on stimuli that initially possessed a ground plane, is a deliberate action coinciding with the stated preference for ground line.

Figures 8:38, and 8:39, showing the ground plane and partial occlusion responses, are very similar and will be discussed together. The majority of subjects at all ages think that a depiction showing ground plane and partial occlusion looks most like a table, and subjects show a developing ability to use these depth cues from about four to twelve years of age. The use of ground plane and partial occlusion on stimulus groups

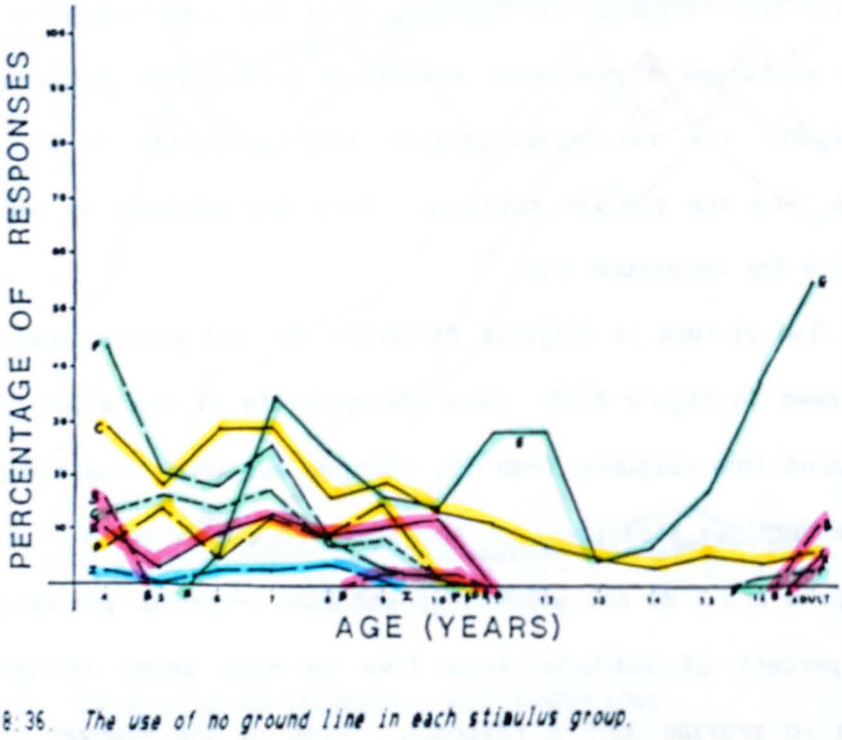


Figure 8:36. *The use of no ground line in each stimulus group.*

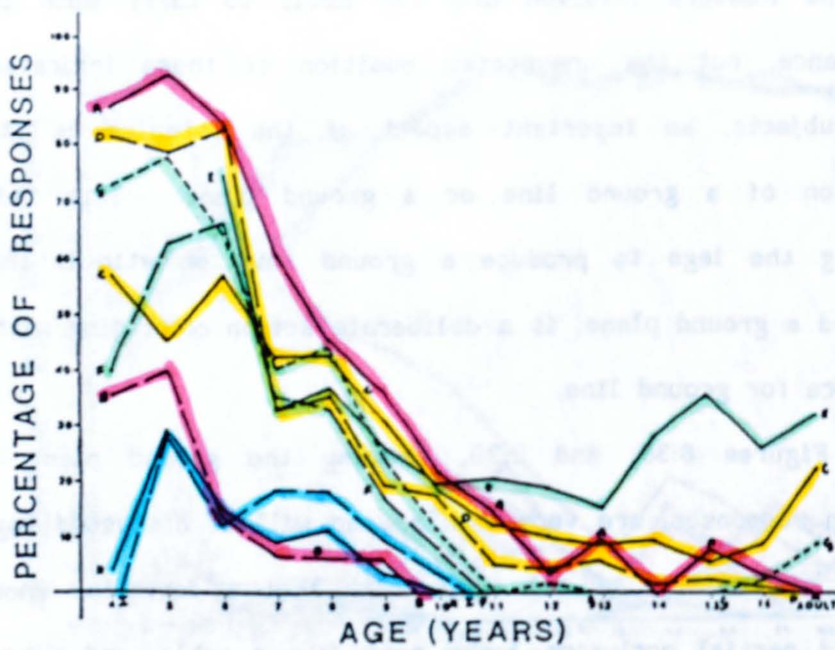


Figure 8:37. *The use of ground line in each stimulus group.*

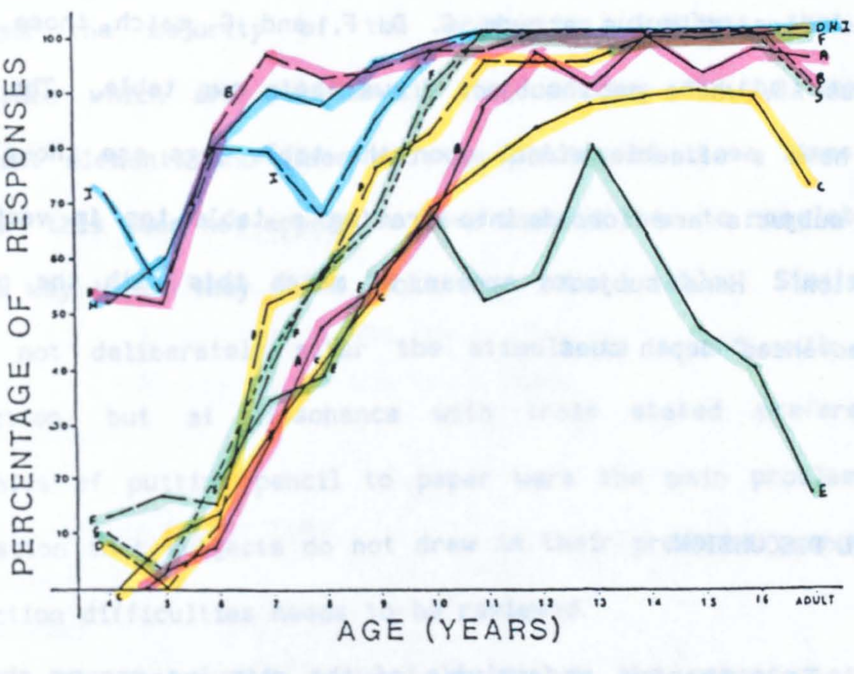


Figure 8:38. *The use of ground plane in each stimulus group.*

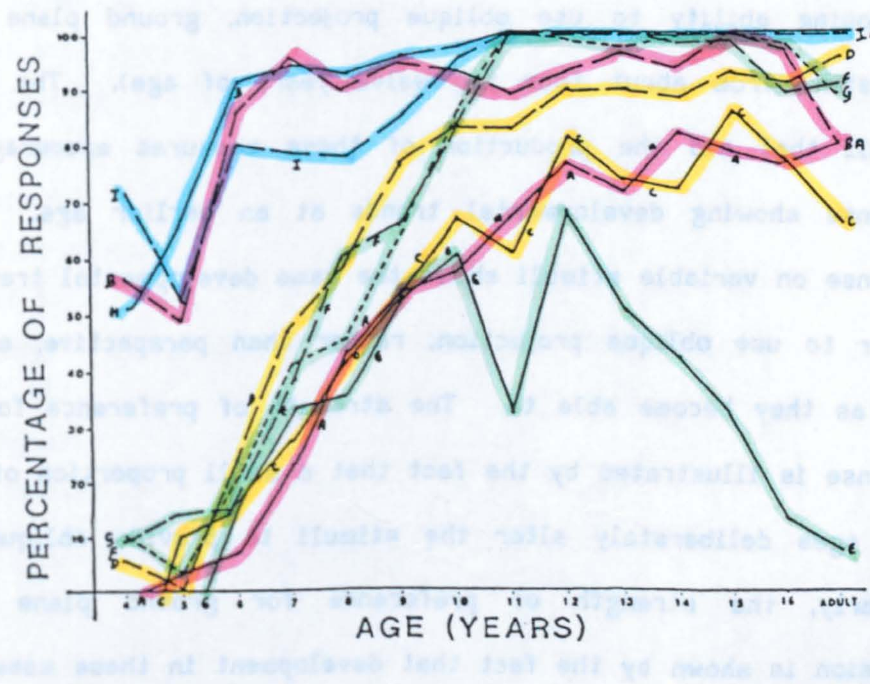


Figure 8:39. *The use of partial occlusion in each stimulus group.*

H and I, where these depth cues are already given, closely matches the subject's stated preference, although some younger subjects do alter the stimuli in both groups to provide a ground line, as discussed above. Responses on stimulus groups C, D, F, and G match those produced on Stimulus A6, where each subject draws their own table. The only stimuli which have a sizeable effect upon the table legs are those in Group C, where subjects are forced into drawing a table top in vertical oblique projection. Here subjects appear to match this with the production of 'less advanced' depth cues.

GENERAL DISCUSSION.

To summarise, an analysis of the stimulus groups shows that the vast majority of subjects at all ages think that a table top in oblique projection and table legs showing the use of ground plane and partial occlusion makes the depiction look most like a table. Subjects show a developing ability to use oblique projection, ground plane and partial occlusion (from about four to twelve years of age). The provision of stimuli that aid the production of these measures encourage a similar response showing developmental trends at an earlier age. The oblique response on variable stimuli shows the same developmental trend. Subjects prefer to use oblique projection, rather than perspective, and do so as soon as they become able to. The strength of preference for an oblique response is illustrated by the fact that a small proportion of subjects at most ages deliberately alter the stimuli to provide oblique projection. Similarly, the strength of preference for ground plane and partial occlusion is shown by the fact that development in these measures is very similar across all stimuli apart from those in stimulus group E.

The discussion at the beginning of this chapter pointed out that subjects had many depictions of tables to copy from, and that we might expect that presenting subjects with a completion task ought to help them overcome the majority of the production problems that they might experience which are related to the ordering of the drawing of the different elements and lines and the placing of these lines in position. However, this does not appear to have enabled them to complete the stimuli in the way which they think looks most like a table. Similarly, subjects would not deliberately alter the stimuli to accord with their normal production, but at dissonance with their stated preference, if the mechanics of putting pencil to paper were the main problem. Hence the suggestion that subjects do not draw in their preferred manner because of production difficulties needs to be reviewed.

Any theory put forward about how the representation of depth develops must both be able to account for this behaviour and for the way in which the use of oblique projection, ground plane, and partial occlusion develops with age in a relatively non-task dependent way.

CONTENTS OF CHAPTER 9.

'Meaning', and the Copying of Line Drawings of Tables.

CHAPTER 9.

'Meaning', and the Copying of Line Drawings of Tables.

The work reported here has been published in the British Journal of Psychology, February 1989, and is given in Appendix 9:A.

Summary.

A series of studies shows that errors in copying line drawings of a table are directly related to the knowledge that the lines represent a table, and not to difficulty in drawing the lines themselves. When children copy the component parts of line drawings of a table the pattern of error is very similar to that obtained when the whole line drawing is copied or when a table is drawn from imagination. When the same component parts are copied without the knowledge of what they represent very few errors are made. This is seen as support for the view that the subject draws what is known and not what is actually seen.

Introduction.

Chapter 7 showed that, under a variety of conditions, most adults prefer a table drawn in oblique projection. Similarly, Chapter 4 showed that most adults prefer to use this projection when drawing from imagination. Chapter 7 also showed that even very young children think that a line drawing in this form of projection looks most like a table, even though they do not use it when depicting a table. Lastly, in the previous chapter, it was shown that when young children were given a completion task in which it was necessary to add only one line to the stimulus some went to great trouble to alter the stimulus so that it accorded with their normal, rather than their preferred, form of depiction. This chapter investigates possible reasons for the difficulty that the child has in depicting the table in his or her preferred form.

There are several possible sources of difficulty. Firstly, the difficulty could be related to the child's conception of a table as a three dimensional object and his or her inability or lack of experience in coalescing three dimensions onto a two dimensional plane. Theoretically, when a child is asked to copy a line drawing the problems of translation from three dimensions to two dimensions are removed, as the subject is presented with the solution to copy. Chen (1985) has shown that copied drawings are usually more advanced than drawings made from a real life model.

Laszlo and Broderick (1985) state that five to six year old children *"Lack the necessary developmental level in both perceptual and motor abilities accurately to copy simple figures"*. They examined perceptual-motor skills in copying diamond, square, and horseshoe shapes, and found that accuracy improved steadily with age, and partially with training. The performance of five and six year olds was poor, and children showed particular difficulty with the diamond and the horseshoe. Laszlo and Broderick argue that planning of action, error detection and error correction may be sources of difficulty. The specific problems shown by young children are identified as inability to copy angles accurately and failure of closure. These errors occur more on the diamond than the square (identical in shape, but rotated through 45 degrees) which indicates that it is not solely the physical shape of the object that causes problems.

Freeman (1980b) suggested that development in table drawing could be related to inability to overcome figural biases. Bremner (1985b) discusses the problem of figural biases and suggests that there are three classes of bias: local bias, figural effects (such as symmetry), and extra-figural effects (such as the edge of paper). These forms of bias might all be relevant here. The first is a local bias, called the perpendicular bias, in which the child shows bias towards drawing one line at right angles to another. The second, related to the first, is an extra-figural effect identified by Naeli and Harris (1976) in which the child might align the vertical sides of the square with the vertical sides of the paper. The third is a bias towards symmetry around an axis. A combination of these might account for the greater difficulty experienced by the young child when copying a diamond rather than a square.

A further source of difficulty, which has been suggested by Phillips, Hobbs, and Pratt (1978), is that a line drawing is seen as a solid object and the internal description created by this will describe the form of that object in three dimensional space. Therefore, although the stimulus is two dimensional, the child may still experience the problem of translating three dimensions to two. Chen (1985) rejects this view. She found that children do not necessarily produce the same drawings when copying a line drawing or when drawing a solid model. In particular she points out that older children tend to produce more advanced drawings when copying a two-dimensional model than when copying a three dimensional model. She defines more advanced as 'towards perspective representation'. Her criticism assumes that the only difference between copying from a two-dimensional or a three-dimensional model is that of the extra dimension. This ignores any extra figural effects that might occur, such as the relationship between the model, either a piece of paper or a solid object, and the table upon which it is placed, or indeed the whole room. It leads to the assumption that children draw an object in a consistent manner, but this is not always the case (Golomb 1974). Nor is it the case that perspective is necessarily a more 'advanced' form of representation. For example, Chapter 5 shows that the form of projection used by subjects is partially a function of task demands, and that perspective is used as an alternative rather than as a more advanced system. It is quite feasible that extra figural effects might alter the task sufficiently to affect the form of projection used, independently of the dimensionality of the stimulus.

To summarise, the four possible areas of error investigated here are:-

a) The problem of translating three dimensions to two.

b) The problem of translating to two dimensions the three dimensions that are implicit in a two dimensional figure.

c) Problems caused by figural biases.

d) Perceptual-motor problems.

The rationale behind the experimental design is as follows. The manner in which a table is drawn from observation or imagination has been determined in detail in Chapters 3 to 6. These data are used as a base against which a subject's performance can be compared when copying line drawings of a table.

In the first study reported here subjects were asked to copy line drawings of a table in various projections and the data were compared with those obtained previously. This comparison provides information about the difficulty of translating three dimensions to two, but suffers from the possibility of confounding extra-figural effects and the three dimensionality implicit in a two dimensional figure. It does, however, provide a baseline against which performance on the three following studies can be compared. In these studies the subjects were asked to copy 'meaningless' parts of the line drawing. Comparisons with the first study enable figural biases to be isolated, as any similarities to the first study can be attributed directly to the form of the figure. The second study also investigates directly the effect that symmetry might have on figural reproduction. The fifth study enables the effect of implicit dimensionality to be evaluated by giving the 'meaningless' parts meaning, and hence implicit dimensionality, and then comparing the results with those in which the stimuli were meaningless (Studies 2, 3 and 4). Extra-figural effects will have no net influence here because the task of copying a collection of lines is the same in both cases. The only difference between the two tasks is the way in which subjects interpret the lines. A final comparison with Study 1, in which the lines have meaning and the results can be used as a baseline of copying performance, enables the effect of 'meaning' to be investigated.

In order to ensure experimental naivety no subject was used for more than one study.

STUDY ONE.

The Copying of Line Drawings.

In this study subjects were asked to copy line drawings of a table shown in different forms of projection and the data obtained were compared with those discussed in Chapter 4.

Method.

Subjects. The subjects were 795 children from one secondary school and one primary school in Leyland, Lancashire.

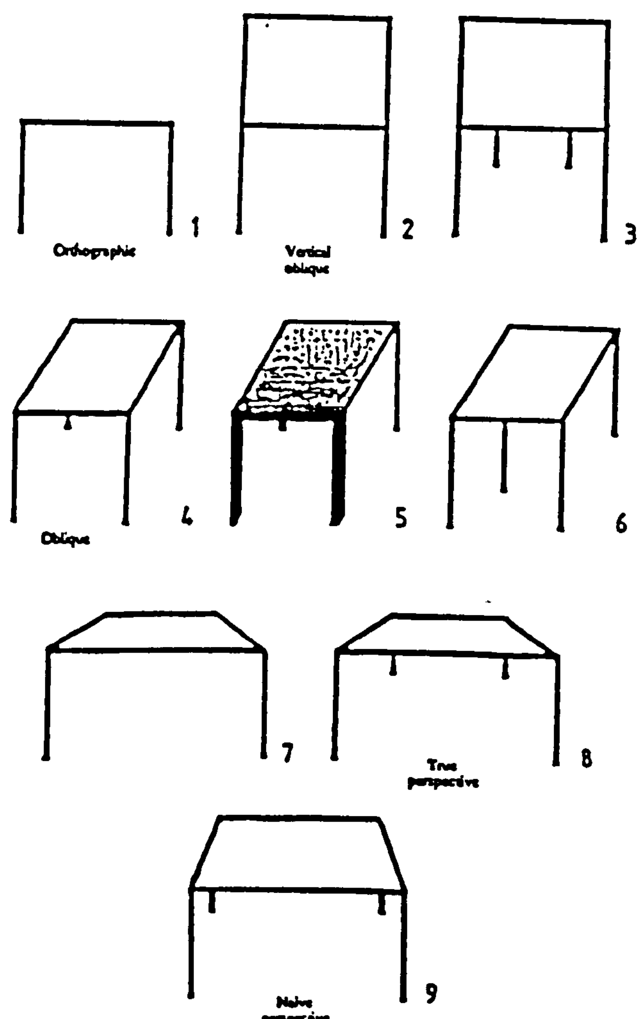


Figure 9:1. *The nine stimuli used in Study 1. See text for details.*

Task. The stimuli used can be seen in Figure 9:1. Each child over the age of ten was given a sheet with either stimulus 1, 3, 4, 8, or 9 upon it. The sheets were distributed in a random manner balanced across age and sex, and each child was asked to copy their particular stimulus accurately. Care was taken to ensure that the child could not see what his or her neighbours were doing.

The remaining 210 children were seen individually. Each child was first asked to draw a table from imagination. The stimuli used for the younger children were 1, 2, 3, 4, 5, 6, 7 and 8. The four extra stimuli used were included to examine the way in which table legs were copied. Each child was asked to copy first one and then another of the eight possible stimuli. The two particular stimuli each child was asked to copy were chosen randomly, balanced across age and sex. This task design enables a check to be made on whether the younger children were actually responding to the stimuli or to some preconceived graphic schema related to table drawing Stimulus 5, identical to stimulus 4 except that implicit depth was enhanced by shading, was introduced to investigate whether such enhancement affected depiction. Figure 9:2 shows the total number of line drawing responses in each age group.

AGE	4	5	6	7	8	9	10 :	11	12	13	14
Stimulus 1	9	8	7	9	8	8	8 :	32	33	30	22
Stimulus 2	7	5	9	6	6	8	8 :				
Stimulus 3	7	6	8	8	8	7	9 :	28	37	31	20
Stimulus 4	7	11	6	7	8	7	5 :	31	34	34	14
Stimulus 5	9	8	7	9	8	8	8 :				
Stimulus 6	7	6	8	8	8	7	9 :				
Stimulus 7	7	5	9	6	6	8	8 :				
Stimulus 8	7	11	6	7	8	7	5 :	27	37	37	18
Stimulus 9							:	29	37	37	16
TOTAL RESPONSES	60	60	60	60	60	60	60 :	147	178	169	90

Figure 9:2. *The number of line drawings in each age group.*

Results.

All drawings were analysed in accordance with the system described in Chapter 3.

PRELIMINARY ANALYSIS. A) Each of the children between 3 and 11 years old copied two line drawings. Forty children produced the same response on both drawings. 13 children also used that response when drawing a table from imagination. These data are shown in Figure 9:3.

AGE		4	5	6	7	8	9		
RESPONSE	Round	2	0	0	0	0	0		
	Orthographic	0	3(1)	0	1	0	0		
	Vertical-oblique	9(5)	7(5)	5	6(1)	2(1)	3		
	Perspective	1	1	0	0	0	0		
Percentage of year		40	37	17	23	7	10	: 19%	*(of total*
		(17)	(20)	(0)	(3)	(2)	(0)	: 6%	*response).*

Figure 9:3. *The number of children producing the same response on both line drawings. The figure in brackets indicates the number who also used the same response when drawing a table from imagination.*

Children who use exactly the same form of depiction for both stimuli nearly all draw in the vertical-oblique form and, as might be expected, are in the lower age groups. The numbers here are low. Only 6% of subjects respond in the same manner across all stimuli, and 19% when copying a line drawing. These subjects were assumed to be making no attempt to follow the task as set, therefore it was deemed justified to exclude them.

B) Each child between four and eleven years of age copied two drawings, and so the responses are not all independent of each other. However, no significant differences were found when Kolmogorov-Smirnov comparisons were made on the proportions of correct responses, with age, between the first and second drawings copied (Orthographic:- $N = 7$, $D = 5$, $p > 0.05$; Vertical Oblique:- $N = 7$, $D = 2$, $p > 0.05$; Oblique:- $N = 7$, $D =$

4, $p > 0.05$; Perspective:- $N = 7$, $D = 2$, $p > 0.05$). Both sets of data were amalgamated for the remaining analyses.

C) A χ^2 comparison of the proportion of correct responses in each age group failed to show a significant difference between stimulus 4 and stimulus 5, as can be seen in Figure 9:4. Because of the small number of responses in this particular analysis a response was taken to be correct if either the top or the legs matched that of the stimulus, although normally both did. For this reason responses to the two stimuli are amalgamated in later analyses.

AGE	4	5	6	7	8	9	10
Stimulus 4	0	12.5	60	75	75	71	100
Stimulus 5	0	25	43	67	63	75	100

$\chi^2 = 8.0$, $df = 5$, $p > 0.1$

Figure 9:4. *The proportions, with age, of correct responses on stimuli 4 and 5.*

D) The older children were given two different perspective tables to copy, one in true perspective (Stimulus 8; 115 degrees convergence) and one in naive perspective (Stimulus 9; 36 degrees convergence). The mean degrees of convergence for each age group on each type of stimulus is given in Figure 9:5.

Age...	11	12	13	14
Naive perspective	40(11.5)	41(11.9)	37(9.9)	44(10.8)
Number of subjects	17	33[1]	37	25
True perspective	50(15.7)	52(18.1)	53(13.7)	61(18.2)
Number of subjects	16[1]	24[2]	34	29[1]

Figure 9:5. *The mean degrees of convergence, with age, when copying a table in either true or naive perspective. The standard deviation of the mean is given in round brackets beside each figure. The figure in square brackets represents the number of subjects who failed to give a perspective response (less than 20 degrees convergence).*

It can be seen that more accuracy was achieved when copying a table in naive perspective than when copying a table in true perspective. Although only five subjects failed to use perspective, the degree of convergence in the stimulus only appears to have a minor effect upon that shown in the response. Because of the lack of difference in response between the two stimuli, responses to them are amalgamated for the remaining analyses.

MAIN ANALYSIS.

A) Copying of the table tops. Figure 9:6 shows the responses analysed in relation to the type of table top given in the stimulus. This provided four classes of stimulus, orthographic (stimulus 1), vertical-oblique (Stimuli 2 and 3), oblique (Stimuli 4, 5, and 6), and perspective (Stimuli 7, 8, and 9).

A two sample χ^2 test failed to show a significant difference between the proportion of correct responses, with age, for orthographic and vertical-oblique stimuli (χ^2 = 4.9, df = 10, $p > 0.8$). Similarly, a three sample χ^2 which included the correct responses for perspective stimuli failed to show a significant difference (χ^2 = 20.7, df = 20, $p > 0.3$). However a four sample test including the responses on oblique stimuli showed significant differences (χ^2 = 198.4, df = 30, $p < 0.001$).

Age...	4	5	6	7	8	9	10	11	12	13	14
No. responses	50	48	60	60	58	60	60	147	178	169	90
Orthographic stimuli.											
Round	12										
Orthographic	66	60	86	100	88	100	88	100	100	100	100
Vertical-ob.	22	40	14		12		12				
Vertical-oblique stimuli											
Orthographic	26	12									
Vertical-ob.	74	55	100	80	100	100	88	100	100	100	100
Perspective		33		20			12				
Oblique stimuli											
Round	17										
Orthographic	14	19	13	2							
Vertical-ob.	48	75	63	74	54	20	15				
Oblique		4	22	17	46	80	85	100	100	100	100
Perspective	3			3							
Failure	18	2	2	4							
Perspective stimuli											
Round	20	6									
Orthographic		7	9	14							
Vertical-ob.	25	31	27	21	7	21					
Oblique									2		
Perspective	55	56	64	65	93	79	100	100	91	100	100

Figure 9:6. *The proportions of response, with age, for stimuli with a table top in orthographic, vertical-oblique, oblique or perspective projection (measured as a percentage of the total response for that age).*

Figure 9:6 also shows that where errors do occur they rarely take the form of an oblique response. The majority of errors on orthographic, oblique and perspective stimuli are caused by vertical-oblique responses, and on vertical-oblique stimuli they are caused by orthographic responses.

Oblique stimuli elicit a form of response that is qualitatively different from responses on the other stimuli. The similarity in the proportions of errors from the other three forms of stimuli indicate that these errors might be related to developmental factors linked to skill in copying. The oblique stimuli appear to present further problems that can only be related to either figural biases unique to those stimuli (such as in the drawing of two oblique parallel lines), or to some form of 'gestaltian' perception of the figure itself.

B) Copying of the table legs.

Analysis of the stimuli related to the way in which the table legs are depicted provides three stimulus groups:- no implicit depth (stimuli 1, 2 and 7), implicit depth in a perspective manner (stimuli 3 and 9), and implicit depth in an oblique manner (stimuli 4, 5 and 6). In this analysis a response was considered correct if the table legs were depicted correctly, regardless of how the table top was drawn. Figure 9:7 shows the proportions of correct responses with age for each stimulus.

A three sample χ^2 test failed to show a significant difference between stimuli 1, 2 and 7 ($\chi^2 = 7.1$, df = 12, $p > 0.8$). All age groups showed little difficulty in copying table legs which involved no depth. Similarly, a Kolmogorov-Smirnov two sample test failed to show a significant difference between stimuli 3 and 9 ($D = 0.09$, $p > 0.05$). Both forms of stimulus elicit, with age, a steadily increasing ability to copy table legs in perspective. Responses for table legs in oblique depth show interesting variations. There are significant differences between stimuli

6 and 4/5, as shown by a two sample Kolmogorov-Smirnov test (D = 0.5, $p < 0.05$). However, 43% of errors on stimuli 4/5 take the form of the table shown in stimulus 6, with the back leg which falls between the two front ones elongated, whereas 20% of errors on stimulus 6 take the form of tables shown in stimuli 4 and 5 (true oblique). When this form of error is included in the analysis (i.e. when those drawings in which the subject is showing depth, but has not depicted the table legs with the same relative lengths as shown in the stimulus, are judged correct), a Kolmogorov-Smirnov two sample test fails to show any significant differences between the stimuli (D = 0.09, $p > 0.05$). Figure 9:8 shows the results obtained when responses are analysed in this way.

Age...	4	5	6	7	8	9	10
No. of responses...	50	48	60	60	58	60	60
No implicit depth							
Stimulus 1	100	76	100	100	100	100	100
Stimulus 2	100	76	85	100	100	100	100
Stimulus 7	100	50	84	100	100	100	100
Average	100	67	90	99	100	100	100
'Oblique' depth [A]							
Stimulus 4/5	0	0	41	18	25	33	0
Stimulus 6	0	0	0	0	63	67	56
Average	0	4	20	9	44	50	28
'Oblique' depth [B]							
Stimulus 4/5	6	32	59	70	82	87	100
Stimulus 6	0	33	14	60	76	100	88
Average	3	33	37	65	79	94	95
'Perspective' depth							
Stimulus 3	0	34	43	60	63	84	89
Stimulus 9	20	38	40	25	63	57	80
Average	10	36	42	43	63	71	85

Figure 9:7. *The proportions of correct responses, with age, for each stimulus and for each stimulus group. 'Oblique' depth [B] includes marginal errors, see text for details.*

AGE.	4	5	6	7	8	9	10
Stimulus 4/5	6	32	59	70	82	87	100
Stimulus 6	0	33	14	60	76	100	88
Average	3	33	37	65	79	94	95

Figure 9:8. *The proportions of response that showed depth on oblique depth stimuli, with age.*

Although even the youngest subjects made very few errors when copying a stimulus with no implicit depth these stimuli were less complex than those with either perspective or oblique depth, the copying of which produced clear developmental trends. A Kolmogorov-Smirnov two sample test fails to show any significant differences between these last two groups of stimuli ($D = 0.07$, $p > 0.05$). These two groups of stimuli appear to elicit similar forms of error, however, it is unclear whether the errors can be attributed to the greater complexity of the stimuli, implicit depth in the stimuli, or a combination of the two.

Development in the copying of a table top in oblique projection or table legs in oblique projection or perspective is similar to development shown in drawing a table from imagination. The proportions of children responding correctly at each age are significantly correlated between the three groups (Table top and Imagination :- $r = 0.93$, $df = 9$, $p < 0.001$; Table top and Table legs:- $r = 0.93$, $df = 5$, $p < 0.01$; Table legs and Imagination:- $r = 0.84$, $df = 5$, $p < 0.05$). Having a stimulus to copy elicits more correct responses than if the subject were drawing a table from imagination, but the form of development is similar whether the table is drawn from imagination, copied from stimuli with oblique table tops, or copied from stimuli with legs in implicit depth.

Discussion.

This study establishes base lines against which future copying behaviour can be evaluated. The first question raised by this study is whether the form of the oblique table top itself causes the difficulty children have in copying it accurately. This question is examined in the next study.

STUDY TWO.

The Copying of 'Table Tops'.

The previous study showed that the majority of young children are able to copy a table top in perspective but not in oblique projection. This study is designed to discover whether the difference in rate of error, with age, between the two forms of stimuli is related to figural effects. The main figural differences between the stimuli are: a) symmetry around a vertical axis (in the perspective top), and b) parallel oblique lines (in the oblique top).

Symmetry is an important aspect of a figure (Bremner 1985b). For example, Bornstein *et al* (1981) showed that babies of four months habituate more quickly to symmetrical patterns, and that a preference for symmetry emerges between the ages of four and twelve months and increases with age. Pomerantz (1977) showed a response bias towards symmetry in adults. Five to nine year olds judge symmetrical patterns as simpler than asymmetrical ones (Chipman and Mendelson 1975), and reproduce symmetrical dot patterns more accurately than asymmetrical patterns (Boswell 1976). Bremner and Moore (1984) showed that children copied non-bisection figures as more symmetrical than they should have been, even though this meant shifting away from an existing perpendicular.

Mendleson and Lee (1981) showed that oblique plane symmetry is hardest to detect, and Mackay *et al* (1972) found that children were more able to place horizontal or vertical lines correctly within symmetrical shapes around the horizontal or vertical axes. Failure to copy an oblique table top may therefore be due to its perceived lack of symmetry or to its symmetry around the oblique axis..

Similarly it is known that young children show difficulty when copying acute and obtuse angles (Bremner 1985b), but in this study both forms of table top contain acute angles and children are able to copy those found in perspective stimuli. The main difference between the two forms of stimuli is that the orthogonals in the oblique form are also parallel.

This study was designed to find out firstly whether the effect shown in Study 1 is still evident when only the table tops are drawn, and secondly whether this effect could be attributed either to the symmetry of form and/or to the parallel lines.

Method.

Subjects. The subjects were 171 children, between 4 and 11 years old, from a primary school on the outskirts of Preston, Lancashire.

Task. The subjects were seen as a class, in their classroom. The stimulus, which consists of four components, is shown in Figure 9:9. The stimulus was drawn in large scale upon the blackboard before the class

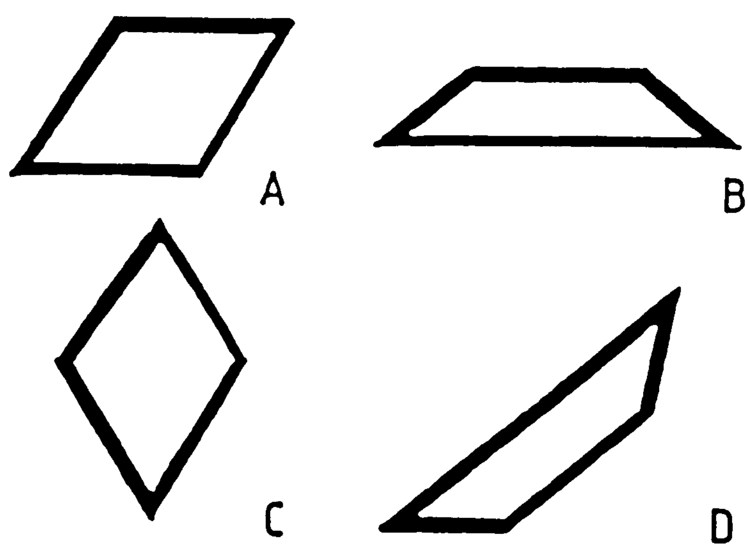


Figure 9:9. *The stimulus used in Study 2. See text for details.*

entered. Each subject was given pencil and paper, and care was taken to ensure that the child could not see what his or her neighbours were doing.

The stimulus was revealed and the teacher asked the subjects to copy it as accurately as they could. When all the subjects had finished, name and age was put on the back of the paper, either by the experimenter, the teacher, or the child.

Results.

The stimulus can be analysed in four separate parts, marked A, B, C, and D in Figure 9:9. Stimuli C and D are identical to A and B but are rotated to give symmetry around a vertical axis in C and oblique parallel lines in D, as can be seen in Figure 9:9. None of these annotations were included in the original stimulus. Responses were measured in accordance with the classification of projection systems described in Chapter 3. Further, the response to stimulus C was only considered correct if it was symmetrical around the vertical axis, and the response to D was only considered correct if the two oblique lines were parallel. Stimuli A and B were the target shapes. As they were identical to the oblique and perspective table tops in Study 1, errors on C or D were not analysed if the subject copied A and B accurately.

AGE		4				5				6	7		8	9	10	11
SUBJECTS		1	2	3	4	1	2	3	4		1	2		1		
STIMULUS	A	•	•	•	•	•	•	•	•		•	•		•		
ELEMENT	B	•	•	•												
	C	•	•	•												
	D	•	•	•	•	•	•	•	•					•		
TOTAL S's		11				23				18	29		25	23	36	5

Figure 9:10. *The number of errors, by subject, and with age, made on each stimulus element.*

Only 11 of the 171 subjects made errors on stimuli A and B. Figure 9:10 shows the errors made by these eleven subjects for each stimulus. Three 4 year olds made errors on each stimulus, and two 7 year olds made no other errors. The remaining six subjects, mostly five year olds, made errors both on stimulus A and stimulus D, but none on stimulus B or C.

Discussion.

The most striking aspect of the results presented here is the lack of error at all ages. Many studies have been done on the way in which children copy diamonds (see Mitchelmore 1985) and the general consensus appears to be that young children have great difficulty with this configuration. The subject population used here did not appear to be unusual, being the intake of a normal state primary school, although there are three aspects of the experimental method that may be relevant. Firstly, because of the focus of the study, errors on part C were only included in the analysis when subjects had failed to copy A or B correctly. In all age groups there were a few children who failed to copy C correctly, but because of the above they did not fall within the scope of the analysis. Secondly, unlike most experiments the parts were presented as one unit. Several studies have shown that children alter their drawings in an attempt to differentiate between stimuli (see Light 1985). It is possible that the presentation of all four parts together increased general accuracy as the children tried to clarify the differences between them. Similarly, Freeman (1983) and Freeman *et al* (1983) suggest that the problem in copying such figures might be related to picture plane bias, which implies that obliquity would have the same effect whether it is in the frame or in the array. It is possible that the presence of all four stimuli in one block lessened this effect in some way. Finally, the copy was judged to be correct if its classification, as determined by measurement, was that of the appropriate projection system. These criteria are less stringent than those that measure minute deviations from the form of the stimulus, and may well add to the surprising lack of error found here. If this is the case it does not detract from the force of the argument presented here which is dependent upon a comparison between errors produced in this study and those from Study 1 rather than an absolute measurement of accuracy of copying.

The sparseness of errors means that the information obtained from the few errors that did occur should be treated with caution. No subjects had difficulty with only A and C, the oblique top, nor with B and D, the perspective top. Therefore errors obtained in Study 1 on these stimuli are not directly attributable to the shape of the table top. Similarly, no subjects had problems with A, C and D, and so error is not attributable to oblique parallel lines. The errors that there were, mainly for five year olds, indicate that the only parts subjects found difficult were those lacking symmetry.

To summarise, low error at all ages leads to the conclusion that young children's inability to copy a table in oblique projection is not wholly attributable to figural bias related to the shape of the table top.

STUDY THREE.

The Copying of 'Table Legs in Perspective'.

Study 1 showed that the majority of young children are unable to copy a line drawing of a table in perspective, and that the majority of errors were made in the way in which the table legs were copied. This study was designed to discover whether these errors are related to figural effects. As has been shown earlier, young children have a tendency, when depicting a table, to extend the back legs so that they are level with the front ones. This occurs whether the table is drawn from observation or from imagination, or whether it is copied from a line drawing or is part of a completion task. There is more than one possible reason for such a bias. If it is caused by a desire for order or neatness of the figure, it should occur whatever the orientation of the figure. If it is caused by the desire to indicate the relationship between the figure and the ground, the effect should only occur when the figure is correctly oriented. This study, therefore, employed two pairs of stimuli (see Figure 9:11) which are mirror images. The prediction is that if the effect is related to the knowledge that the lines represent table legs in perspective, rather than being a purely figural effect, then few errors should be made.

Method.

Subjects. The subjects were 72 children, between 4 and 9 years old, from a primary school on the outskirts of Leyland, Lancashire.

Task. The subjects were seen as a class, in their classroom. The stimulus used can be seen in Figure 9:11. The procedure was the same as that used in Study 2. It can be seen that stimulus elements A and C are identical except for a rotation, as are stimulus elements B and D. Stimulus elements A and B are the target shapes. These annotations were not included in the original stimulus.

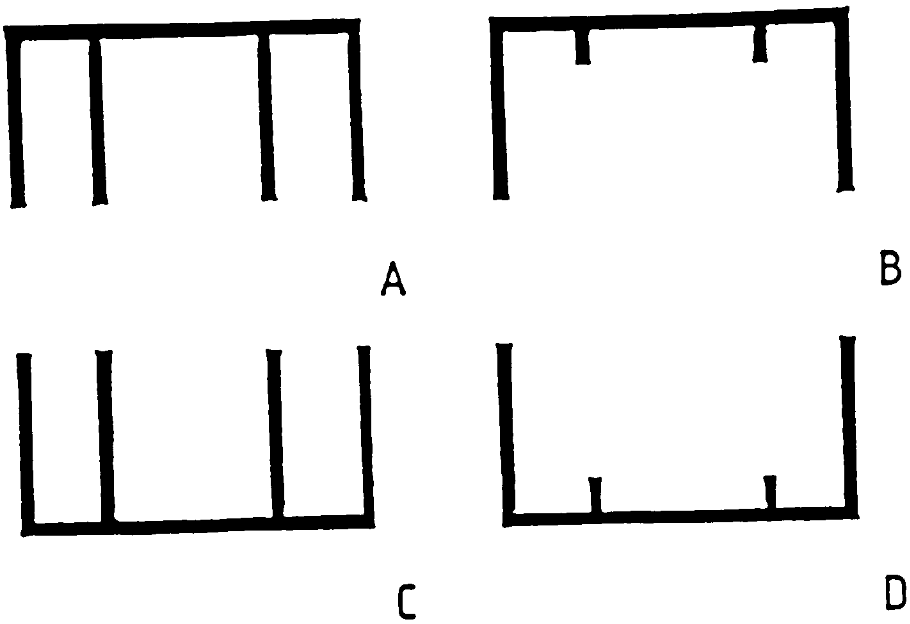


Figure 9:11. *The stimulus used in Study 3. See text for details.*

Results.

The stimulus can be analysed in four separate parts, marked A, B, C and D in Figure 9:11. A response was only considered correct if it was an accurate replica of the part. Six subjects either did not copy the figures in the correct orientation or did not copy the number of legs correctly. These responses were not included in further analysis, as they did not reveal anything about the child's strategy in relation to length of line. Only 5 subjects made any other errors. These are shown in Figure 9:12. The nature of the error in each case was to complete the figure by extending the legs. Two five year olds copied both B and D inaccurately, a child of five years and another of eight years failed to copy B, and a six year old failed to copy D.

AGE		4	5			6	7	8
SUBJECTS			1	2	3	1		1
STIMULUS	A							
	B		e	e	e			e
	C							
	D		e	e		e		
DISCOUNTED		1		4		1		
TOTAL S's		5		28		13	15	11

Figure 9:12. *The number of errors, by subject and with age, made on each stimulus element.*

Discussion.

As in Study 2 the most striking aspect of the results presented here is the lack of error at all ages. Once again the subject population used here did not appear to be unusual, being the intake of a normal state primary school. No subjects had difficulty with only A and C. Only 2 five year olds extended the shorter lines on both parts B and D, possibly showing a desire for figural coherence. One 5 year old and one 8 year old extended the lines on B, possibly showing a desire for a ground line, and one 6 year old extended the lines on D. This makes it difficult to draw strong conclusions about the pattern of errors as a whole.

Many studies have shown the importance of ground line to the young child. For instance, Lowenfeld and Brittain (1966) used drawing to a ground line as a stage in the classification of children's drawings. The flat-bottom error in cube drawing is a good example of this phenomenon. In this the top surface of the cube is drawn correctly as a parallelogram, whilst the sides are extended to form a flat bottom. In an ingenious pilot study Willats (1981a) asked subjects to draw a cube from a model. The model was either resting on a table below eye level, or resting on perspex above eye level. He found that in the second condition the 'flat bottom error' occurred at the top of the drawing. He concluded that the child is conveying the direction from which the object is viewed, not just the surface upon which the object rests. The suggestion that the error is caused by more than figural bias is supported by Freeman's (1986) discussion of the subject.

In conclusion, this study indicates that young children's inability to copy a table in perspective is not wholly attributable to figural bias related to the shape of the table legs.

STUDY FOUR.

The Copying of 'Table Legs in Oblique Projection'.

Study 1 showed that the majority of young children are unable to copy a table in oblique projection. Study 2 showed that this could not be wholly attributed to figural biases associated with the form of the table top. This study was designed to discover whether the errors made by children in Study 1 were caused by figural effects associated with the form of table legs in oblique projection. Study 3 indicated that when table legs are drawn in perspective the lengthening of the back legs is not related to figural bias. However, it is possible that table legs in the form of oblique projection are influenced by such a bias. As discussed earlier, drawing a table in oblique projection involves the accurate depiction of acute and obtuse angles. Young children succeeded in copying these when drawing the table tops, but the child also needs to use an acute angle when copying the 'exposed' back leg of a table in this form of projection. It is possible that children have difficulty with drawing an angle in this position and so make errors where they would not otherwise occur.

Method.

Subjects. The subjects were 170 children, between 4 and 11 years old, from a primary school in Leyland, Lancashire.

Task. The subjects were seen as a class, in their classroom. The stimulus used can be seen in Figure 9:13. The procedure was the same as that used in Study 2.

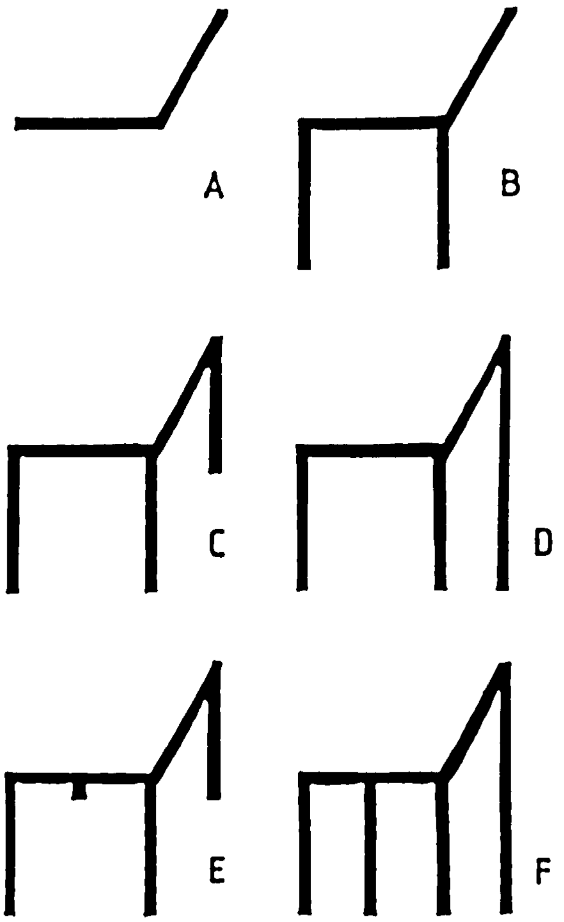


Figure 9:13 *The stimulus used in Study 4. See text for details.*

Results.

The stimulus can be analysed in six separate parts, marked A, B, C, D, E and F in Figure 6. Part A is an obtuse angle. In B, C and E lines are added progressively, such that E contains all the lines necessary for table legs in oblique projection and is therefore the target stimulus, as it is identical in form to the oblique table legs in Study 1. Parts D and F are the alternatives to C and E respectively, in which the table legs extend to a ground line. These annotations were not included in the original stimulus. A response was only considered correct if it was an accurate replica of the part. If a child copied the target accurately but made errors on other parts, these errors were not included in the analysis. Figure 9:14 shows the errors, with age, for each part in the replication of the table legs.

Age...	4			5						6				7			8			9					10					11
Subjects...	1	2	3	1	2	3	4	5	6	1	2	3	4	1	2	3	1	2	3	1	2	3	4	5	1	2	3	4	5	
A	•	r	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
B	•	r	•	•	•	•	•	r	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
C	•	r	•	•	•	•	•	r	•	•	sg	•	j	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	g	•
D	•	r	•	•	r	•	•	r	•	•	s	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
E	sg	sg	g	r	r	j	g	rg	j	j	r	j	j	j	j	j	j	j	j	j	g	sg	j	j	j	g	j	j	g	•
F	s	s	•	•	r	•	•	r	•	•	s	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
No. of subjects	11			23						18				29			25			23					36					11

Key: g = all the legs were extended to a ground line.
j = the inside back leg was drawn slightly longer than the outside back leg.
r = the oblique angle was given as a right angle.
s = the oblique angle was given as a straight line.
No other forms of error were made.

Figure 9:14. *The number of errors in copying the table legs, by subject and with age, made on each stimulus. The letter gives the form of error.*

Analysis was done in two parts. Firstly errors on the copying of the oblique angle were analysed, and then the length of the table legs was examined. Table 4 shows that only seven subjects in total had problems with the angle. Two subjects used straight lines (s), three subjects used right angles (r), and two subjects used a combination of the two on different stimuli. Only one subject had problems with all the stimuli. This subject started using a right angle, but changed to a straight line on the last two stimuli. The other six subjects only produced errors as the stimuli became more complex. Twenty seven subjects made at least one error in copying the length of the lines. The criteria were, however, very stringent, and almost all of these errors were only marginal, classed as 'j' in Figure 9:14. The errors occurred when subjects retained the relative lengths of the lines but showed a tendency to extend the inside back leg slightly. Chapters 3, 4 and 8 have shown that this is a frequent error when a table is drawn from a model, from imagination, or in a completion task. The error in copying legs that is being examined here, that of extension of all the lines to ground line (g), was made by eight subjects, but not in a consistent manner. For example, six year old subject 2 makes this error on an easy part but not on a more complex one. The errors are spread across the age range and do not appear to indicate a consistent figural bias.

Discussion.

As in the previous two studies the most striking aspect of the results presented here is the lack of error at all ages. Once again the subject population used here did not appear to be unusual, being the intake of a normal state primary school, but again the study was unusual in that the parts were presented as one unit. More errors appear to be made as the parts become more complex, but there appears to be no consistent pattern in the type of errors made.

It is suggested that young children's inability to copy a table in oblique projection is not entirely caused by figural bias related to the shape of the table legs.

STUDY FIVE.

Copying and Knowledge of what the Lines Represent.

This study was designed to discover whether the errors evident in Study 1 are caused by the knowledge of what the lines represent rather than by figural effects associated with the form of the line drawings. The target stimuli in each of the above studies were therefore presented again, together with an explanation of how they fit into a line drawing of a table.

Method.

Subjects. The subjects were 109 children, between 4 and 8 years old, from one infant school and one primary school in Leyland, Lancashire.

Task. The subjects were seen as a class, in their classroom. The stimulus used can be seen in Figure 9:15.

The stimulus was drawn in large scale upon the blackboard before the class entered. Each subject was given pencil and paper, and care was taken to ensure that the child could not see what his or her neighbours were doing. The stimulus was revealed, and it was explained how the perspective top fitted to the perspective legs, and the oblique top fitted to the oblique legs. The subjects were asked to imagine what they would look like if they were pushed together, and they were told that the drawings would both look like tables although they would be drawn in different ways. The teacher then explained that nobody was to actually draw a table, and asked the subjects to copy the lines on the blackboard as accurately as they could. When all the subjects had finished, name and age was put on the back of the paper, either by the experimenter, the teacher, or the child.

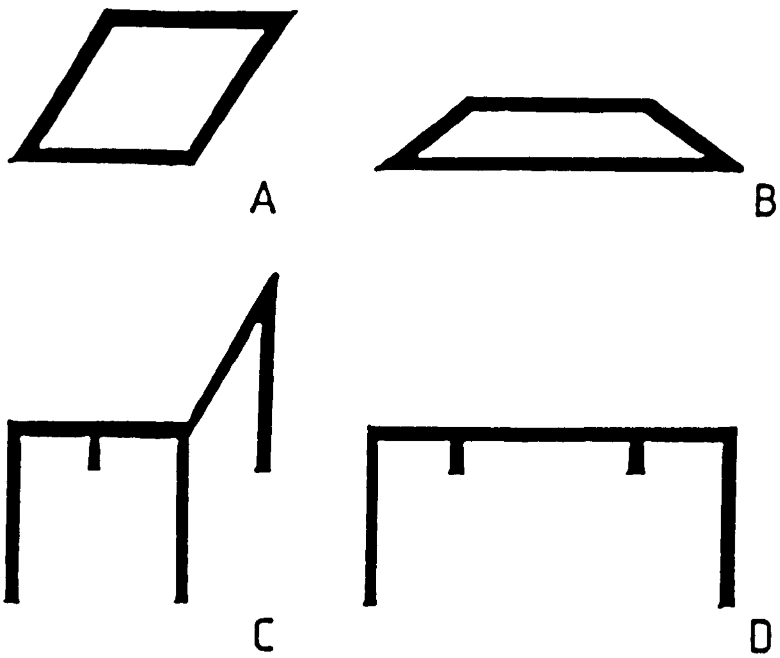


Figure 9:15 *The stimulus used in Study 5. See text for details.*

Results.

The stimulus can be analysed in four separate parts, marked A, B, C and D in Figure 9:15. These annotations were not included in the original stimulus. A response was only considered correct if it was an accurate replica of the part. Figure 9:16 shows the forms of response, with age, for each stimulus.

These results show that the youngest children had difficulty with each part of the stimulus. In conjunction with the results reported earlier in this paper they also show that children and adults extend the inside back leg slightly when drawing table legs in oblique projection, as in error type y. Although this is not an absolutely correct response, it does accord with the spirit if not the letter of the law. Both here and in previous studies subjects of all ages appear to use this as an alternative method of depiction, hence this response is classed as correct for the purposes of comparison.

PART OF STIMULUS: A

AGE			4	5	6	7
Type	○	a	4			
of	□	b	16	20	14	10
error	△	c		1		
	◇	d		4	6	8
	spoilt		2			
	correct		1	3	4	8
% of total			4	11	17	24

PART OF STIMULUS: B

AGE			4	5	6	7
Type	○	a	5			
of	□	b	5	9	5	6
error		e			2	
	correct		13	19	17	28
% of total			57	68	71	82

PART OF STIMULUS: D

AGE			4	5	6	7
Type	□	b	1	1		
of		f	2	1		
error		g	3			
		n	2	1		
		o	11	9	4	2
	correct		4	16	20	32
% of total			17	57	83	94

PART OF STIMULUS: C

AGE			4	5	6	7
Type	○	a	1			
of		f	2	1		
error		g	4	4		
		h	1			3
		i	4	2		
		j	1	1		
		k				4
		l	1	2		
		m		1		
		n		1		
		o	4	1	5	4
		p	1	3		
		q		1		
		r			1	1
		s				1
		t	2	1	6	2
		u		2		2
		v		1	2	1
		w			1	
		x				6
		y		2	5	4
	spoilt		2	2	2	
	correct			3	2	6
% of total			0	11	8	18

Figure 9:16. *Types of error made in Study 5. This figure gives the number of subjects making each error and the total percentage of correct response, with age, for each part of the stimulus. The total number of subjects in each age group was 23, 28, 24 and 34 respectively.*

When the proportions of errors for each age are compared by a two sample one-tailed Kolmogorov-Smirnov test with those elicited by the target parts of the stimuli in studies 2, 3 and 4 a significant difference between the two is found for parts A, C and D, but not for B (the lines representing a table top in perspective). (Part A v. Part A: Study 2: D = 0.16, $\chi^2 = 6.1$, df = 2, $p<0.02$; Part B v. Part B: Study 2: D = 0.02, $\chi^2 = 0.25$, df = 2, $p > 0.7$; Part C v. Part E: Study 4: D = 0.21, $\chi^2 = 11$, df = 2, $p < 0.001$; Part D v. Part B: Study 3: D = 0.2, $\chi^2 = 24.4$, df = 2, $p < 0.001$). However, Kolmogorov-Smirnov two-sample one-tailed tests failed to find any significant differences between the proportions of errors with age obtained in this study and those produced for either the table tops or the table legs on the appropriate stimuli in Study 1 (in which the complete line drawing is copied). (Part A v. The copying of the top of the oblique table in Study 1: D = 0.13, χ^2 = 1.8, df = 2, p > 0.2; Part B v. The copying of the top of the perspective table in Study 1: D = 0.02, χ^2 = 0.21, df = 2, p > 0.7; Part C v. The copying of the legs of the oblique table in Study 1: D = 0.09, χ^2 = 1.6, df = 2, p > 0.2; Part D v. The copying of the legs of the perspective table in Study 1: D = 0.04, χ^2 = 0.54, df = 2, p > 0.3).

Discussion.

Subjects in either this study or in studies 1 or 2 showed little difficulty when copying a table top in perspective. Each part of the stimulus presented in this study was identical to one presented in either study 2, 3 or 4, yet there were significant differences between the way the subjects in this study copied parts A, C and D, (table top and legs in oblique projection, and table legs in perspective) and the way subjects copied identical parts in the three other studies.

Earlier it was argued that the ease with which the target parts of stimuli were copied could be related to the fact that they were presented in conjunction with similar line drawings which might increase the saliency of minor differences between them. In this study all the target parts of stimuli were presented together. It is possible that the stimulus used here differed sufficiently to cause distraction rather than increased discrimination. If that is the case one might suppose that a comparison between the responses obtained with the stimulus used here and those obtained with the more complex stimuli used in in Study 1 would show the same effect. However, one-tailed tests failed to show any significant differences between the patterns of error obtained here and those obtained in Study 1.

An alternative, and more convincing, explanation is offered by another aspect of the results. In Study 1, when subjects were asked to copy line drawings of a table in different projections, subjects showed difficulty with the top and legs of the table in oblique projection and with the legs of the table in perspective. These particular difficulties were replicated by the subjects in this study. The stimuli used here generally elicited slightly more correct responses than elicited by table tops or table legs in oblique perspective and by table legs in perspective, which may be attributable to the greater complexity of the stimuli in Study 1, but the patterns of errors in the two studies are remarkably similar. The only feature shared by the stimuli in Study 1 and the parts of the stimulus used in this study is the subject's knowledge of the object that is being represented.

To conclude, the pattern of errors obtained for each part of the stimulus was more closely related to that obtained on the relevant part of the different, and more complex, stimulus presented in Study 1 than it was to that obtained on a stimulus identical to the individual part, as presented in studies 2, 3 and 4. The point of similarity between this study and Study 1 is that subjects knew in each case that what they were drawing represented a table. This knowledge substantially altered the subjects' response on two otherwise identical tasks. Questions about why this effect is only apparent when table tops and legs in oblique projection and table legs in perspective are copied are examined in the general discussion that follows.

GENERAL DISCUSSION.

In the introduction to this chapter four possible areas of investigation were outlined:

a) The problem of translating three dimensions to two.

b) The problem of translating to two dimensions the three dimensions that are implicit in a two dimensional figure.

c) The problems caused by figural biases.

d) Perceptual-motor problems.

These problems were examined by the five studies presented here, in relation to those described in Chapters 3 to 6.

Chapters 3, 4 and 5 looked at the way in which subjects draw a table from observation or from imagination, and identified general trends in development independent of the task. These trends were from the use of orthographic to affine and projective systems of natural perspective. Data obtained in Chapter 4 were used as a baseline from which to judge the problems of translating three dimensions to two.

The first study reported in the present chapter showed that if problems (a) and (b) above are avoided by presenting two dimensional stimuli, errors only occur when a table is in oblique projection or when the table's legs are in perspective.

The next three studies examined whether these errors were caused by figural biases or perceptual-motor problems specific to the form of the error producing stimuli. In each study this was found not to be the case.

The last study examined whether the errors were caused by the problem of translating to two dimensions the three dimensions that are implicit in a two dimensional figure. The stimuli were identical to those used in the previous three studies, on which subjects had produced very few errors, but subjects in this study were given the added information that the lines formed part of a table drawing. The pattern of errors produced was the same as that in Study 1, when subjects also knew that the lines represented a table, and was totally unlike those elicited in Studies 2, 3, and 4.

It would appear that when subjects appreciate that the stimuli might be more than a collection of lines and could represent part of a table they unwittingly attempt to represent the three-dimensionality that is now associated with these lines. Their performance on the task is then similar that of subjects of their particular age in tasks requiring the representation of three-dimensionality, in that younger children no longer copy the stimuli accurately and produce the same errors that they would if they were drawing a three dimensional object. The same argument is used by Deregowski (1976 and 1978b). Deregowski and Strang (1986) used three dimensional stimuli to show that the difficulty in representation might lie in the conflict between the desire to convey the overall appearance of the object and the attempt to depict its elements correctly. The degree of dimensionality of the stimulus is a different, though normally inseparable, variable to that of completeness of the stimulus. The studies reported here separate these two variables and suggest that the elementary parts are generally only depicted correctly if they do not have the 'meaning' of the whole. In conclusion it is suggested that the knowledge that the lines represented a table, a three dimensional object, caused the majority of errors obtained in Study 1, and hence that the hypothesis put forward by Lazlo and Broderick (1985), that failure to copy simple figures is largely due to perceptual-motor errors, needs modification.

If this is the case, why do subjects only have problems with table tops and table legs in oblique projection, and table legs in perspective? What is it about these that implies depth, that the other forms of stimuli used in Study 1 do not have? For example, a table top in perspective might also be expected to imply depth. However, its trapezoidal shape, with the enlarged base, gives the appearance of sitting on a ground line rather than a ground plane. It looks like a balanced geometrical shape. Even with the knowledge that it represents a table top one can infer that it is a complete object on its own.

An oblique table top is unsymmetrical, and it has been shown that lack of symmetry does play a part in errors in copying this shape. However, it was also shown that this is not the whole reason. Mitchelmore (1985) suggests that an acute angle, in itself, might indicate depth, in that it is spontaneously interpreted as a representation of a perpendicular in three dimensions. The parallels in the oblique table top form one actual acute angle and one implicit acute angle. Whilst the shape itself is copied with little error, the added knowledge that it could be a table top might trigger a spontaneous interpretation of depth.

It is easier to see how table legs in either oblique projection or perspective can have implicit depth. If the back lines are understood to be table legs then both forms of stimulus imply hidden line elimination, in that the legs that come from the back must be partially hidden by the table top, and subjects 'know' that table legs must be of the same length and thus they are reproducing an invariant attribute of tables. As has been shown earlier, two common methods employed by young children are the drawing of all the table legs to a ground line or the showing of them radiating from the table top. This is also the explanation given for the partial extension of the inside back leg in a table drawn in oblique projection, a form of error to which even adults are very prone and one that is evident in the studies described here.

It can be seen that implicit depth is apparent in each of the stimuli that children find problematical. The points raised here tie in closely with, and support, Mitchelmore's (1985) thesis which argues against a close relationship between isographic and homographic errors. Essentially, isographic drawings do not have implicit depth whilst homographic ones do. The difficulty, as Mitchelmore indicates, is in designing an experiment which isolates the productive aspects of isographic and homographic drawing. The studies reported here attempt to do that. Studies 2, 3 and 4 can be considered as isographic whilst Study 5 can be seen as their homographic equivalent. The findings reported here strongly support the view that there is not a close relationship between the two. Freeman (1986), in summarising experiments on cube drawing, suggests that "*what the children learned was how to relate lines on the page to their mental descriptions of the particular object; they did not learn how to solve 'the problem of depth'.*" Similarly Arnheim, (1974) argues that the simplicity of children's schematic representation does not reflect graphic incapacity so much as the basic analytical categories through which the child organises his or her world.

There are notable exceptions to the general development in drawing ability that have been described throughout this thesis. Some autistic children show remarkable ability at a very early age, depicting complex scenes from imagination quickly and with photographic accuracy (Selfe 1977, 1983b, 1985). By contrast, even those normal children who artistically gifted only show development a few years above their chronological age (Harris 1963), and the drawings of other mentally retarded children are comensurate with their mental age (Stotijn-Egge 1952). Further, the unusual drawing ability shown by these autistic children is not related to enhanced spatial ability, as this is usually found to be in keeping with their mental age (Hobson 1984).

Some lower I.Q. adults also show remarkable drawing ability. O'Connor and Hermelin (1987) examined the relationships between intelligence and artistic ability on the one hand and skill at the recognition, matching, reproduction and copying of two dimensional shapes with two levels of complexity and structure on the other. Their sixteen subjects were adults with an I.Q. of approximately 50, eight of whom were idiot-savant artists and the other eight of whom formed a control group. Four subjects in each of these groups had been diagnosed as autistic or showed autistic features in their behaviour. The remaining sixteen subjects were eleven to thirteen year old children of normal intelligence, eight of whom were artistically able. It was found that higher I.Q. groups were better at the recognition and matching of two dimensional non-representational shapes, but idiot-savant artists were found to be as good as higher intelligence subjects and significantly better than I.Q. matched subjects when graphic production was required. This was also the case when graphic output was considered independently of any similarity between a drawing and a model. They concluded that "the difference between the level of performance in visual as compared with visual-graphic tasks is determined by a specific I.Q.-independent ability".

What is this ability? The drawing ability of the idiot-savant artists was well above average, even though their reproduction and copying scores, and levels of motor coordination, were not found to be superior to those of normal controls. O'Connor and Hermelin suggest that the efficient accessing of graphic motor programmes depends more on artistic competence than on intelligence and the ability to evoke visual images. They suggest that drawing might be partially independent of visual memory, and related more to encoded motor programmes primed by the sight of the model, and comment that *"the efficient use of domain-specific motor programmes by idiot-savant artists may indicate some sparing of cerebellar and/or motor cortex structures independently of whether they are autistic or not"*. O'Connor and Hermelin also point out that their tasks are only tangentially related to artistic ability, as are the two-dimensional, non-relational stimuli they used, because normally the artist is more concerned with depicting a three dimensional form in two dimensions. However, they do hypothesize that the idiot-savant might have " *acquired his high level of skill in drawing familiar scenes and objects because these allow him to draw on his long-term visual memory as well as on well-practised graphic descriptions*".

Selfe (1983b) found that autistic children with anamolous drawing ability normally executed their drawings from memory, although they did not rely upon it entirely. It is worthwhile quoting her extensively as her work is very pertinent to the discussion. She states that:

"*All of the subjects had severe learning problems and had some degree of mental retardation. All had many of the features of autism (Rutter, 1978; Newson, 1979). In particular, all the children had suffered from delayed and deviant language development, and the majority still had very restricted or bizarre language. All subjects had severe problems with social behaviour, and had had, or still had obsessions, rituals and bizarre mannerisms. An analysis of their drawing habits showed that all the subjects had started to draw representational drawings at an early age and this had not been preceded by the usual stages of scribbling and experimentation. All the subject's drawings, from an early age, had been fixed-viewpoint drawings of scenes or objects, frequently those objects that were of obsessional interest to the child. The drawings are therefore described as anamolous. (p 142).......He* (the child with normal, if accelerated, drawing ability) *represents those objects that have functional significance for him. The production of a characterising and meaningful symbolic representation appears to be more important than attention to idiosyncratic details or to a single view of an object. The autistic subjects, however, appear to be attending to non-symbolic aspects of visual experience. Objects are* *truncated or partially occluded and represented without their defining characteristics, as seen from one fixed viewpoint. This type of drawing is necessarily autistic and asocial in so far as one single viewpoint is possible only to one single viewer at one fixed spot. It is therefore hypothesised that the autistic child, in drawing, records objects in his optic array more as patterns - edges, contours and shapes - rather than as representatives of classes or symbols. It is perhaps coincidental that adult layman generally value photographic realism in drawing and that this feature is the hall-mark in the drawings of the autistic group (p150)." (1985).*

She showed that such children do not appear to go through the same developmental sequence as normal children. In particular, they appear not to show a 'conceptual' phase in their development. Paine (1981) made the same point when discussing children with exceptional artistic ability.

Arnheim (1980) suggested that Nadia (an idiot-savant artist) was not just 'copying' a form of eidetic imagery because she altered the scenes to accord with her own style. Baron-Cohen *et al* (1985) found that autistic children fail in *conceptual* perspective-taking skill, as opposed to *perceptual* perspective-taking tasks, in which they succeed. Baron-Cohen (1987) argues that if a symbol is interpreted as a representation of something else, then autistic children can create symbols. However, symbolic play involves second order representations in which the symbol is a representation of a concept, and it is in this area that autistic children fail. Thus they have a capacity to produce signs but not representations of concepts. Baron-Cohen *et al* (1985) conclude that this constitutes a specific cognitive defect that is largely independent of general intellectual level and has the potential to explain both lack of pretend play and social impairment by virtue of a circumscribed cognitive failure. It must be emphasised that not all autistic children show exceptional drawing ability, but it is possible that this cognitive deficit plays a part in the drawing of those that do.

This chapter has shown that the ability of normal children to copy lines is affected adversely by the 'meaning' that these lines hold for the child. Unfortunately little work has been reported about the relative ability of subjects with anamolous drawing ability to copy isographic and homographic drawings. Idiot-savant artists are relatively poor at visually matching or recognising abstract shapes whilst they are relatively good at copying. Studies of drawing in autistic children have investigated free drawing, rather than the children's ability to copy lines, although Selfe (1977) reports that Nadia showed ability at copying lines accurately. The exceptional aspect of the drawings produced by both idiot-savant artists and by autistic children with anamolous drawing ability is shown in the way in which they can depict a three dimensional scene in two dimensions with photographic realism. Information on autistic children suggests that those with anamolous drawing ability are not limited by the symbolic importance of lines. It is possible that all exceptional artists share this feature in some way. It is interesting to speculate that the cognitive deficit in autistic children suggested by Baron-Cohen et. al. is related to the children's lack of attendance to the symbolic aspects of visual experience found by Selfe, and that the failure to copy meaningful lines in normal children is related to a lack of this deficit.

An interesting line of research would be to investigate the patterns of error elicited if the studies reported here were replicated with autistic children with anomalous drawing ability.

CONTENTS OF CHAPTER 10.

General Discussion of Findings.

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General Discussion of Findings.

A) Overview of Findings.

Chapter 3 investigated the way in which adults and children use projection systems when drawing a table from observation. It was found that different forms of projection were used, and that older subjects used more complex forms of projection. However, the data did not support the view that development is directly linked to the understanding of projection systems. The most complex form of projection studied, linear perspective, was used incorrectly by all subjects. Oblique projection was used by a steady minority of older subjects, even though this did not accord with the view that they had of the table. The majority of younger subjects used orthographic or vertical oblique projection, and there appeared to be little progression from the use of one to the use of the other.

Chapter 4 looked at the way in which adults and children draw a table from imagination. Here it was found that the majority of older subjects drew a table in oblique projection. Very few used any form of perspective, and the proportion of those doing so peaked at about fourteen years of age. This is the age at which linear perspective is taught in art lessons in the majority of schools from which the subjects were obtained. The majority of younger subjects used orthographic or vertical oblique projection. Little difference was found between these two systems in the proportions of subjects using them, with age, and hence it was concluded that they are used in an equivalent way.

A comparison between this study and that discussed in Chapter 3 showed that the use of oblique projection or perspective is dependent upon whether subjects have been asked to draw from imagination or observation.

This task dependency becomes more marked from about ten years of age. There is no task dependency with orthographic and vertical oblique projection. It was also shown that there is development in the depiction of depth that is not directly related to the use of projection systems and is independent of the task.

Chapter 5 investigated the task dependency shown in the previous chapter. The older subjects' use of oblique projection when drawing a table from imagination and use of perspective when drawing a table from observation was found to be unrelated to saliency of background, knowledge of perspective, or level of artistic ability. It was found that the most important factor is the degree of centrality of viewpoint specified in the stimulus. When the stimulus specified a central viewpoint the majority of older subjects used perspective, and when no viewpoint was specified the majority of older subjects used oblique projection.

These three chapters taken together showed that development in the depiction of depth is not uniquely related to development in either the understanding or the use of projection systems. They showed that younger subjects tend to use orthographic and vertical oblique projection in an equivalent manner, whilst older subjects used either oblique projection or perspective depending on the task constraints. It was necessary to make a more detailed analysis of the way in which tables were drawn, in order to identify developmental trends that are not task related, but whose existence had been inferred from the above findings. Chapter 6 set out a formal classification system of table drawings. This system utilises the way in which both the table top and the table legs are drawn, and is independent of any previous theories about how the depiction of depth develops. The data presented in Chapters 3 and 4 were classified according to this system. It was found that the use of depth cues within the drawing of a single table could be identified from the way in which the relationship between the table top and each of the table legs is depicted. The depth cues identified were partial occlusion and height in the picture plane. Use of the latter occurs in three stages: absence of ground line, use of a ground line, and use of a ground plane. Diminishing size with distance could not be identified by examining the way in which the table legs were drawn, and could only be inferred from the depiction of the table top. An analysis of the developmental trends found in the use of depth cues identified in this way showed that such development is independent of task. It also showed that subjects used the depth cues necessary for the production of a particular projection system before they used that form of projection.

The studies reported in Chapter 7 used a series of tasks in which subjects had to choose the form of depiction they preferred from a series of drawings. This was done in order to investigate whether children prefer tables to be drawn in the manner that they themselves would use, or if they are constrained by an inability to use more complex depth cues. It was found that the majority of all subjects preferred depictions showing the use of oblique projection, ground plane, and partial occlusion. These preferences held true across a variety of conditions, and for all ages. It remained the case even when a real table was placed in front of the subjects and they were asked which depiction they thought looked most like it. Under these conditions the vast majority of subjects up to ten years of age chose a table depicted in oblique projection. After this age the proportion of subjects preferring perspective increased gradually, but the proportion of subjects preferring oblique projection did not drop below approximately fifty percent even for the group aged thirteen and above. The strong preference for the use of ground plane and partial occlusion was unaffected by this task. These last findings support those presented earlier that suggest that sensitivity to centrality of viewpoint becomes a salient feature of the task at about ten years of age.

In one study the wording of the question was altered and it was found that this alteration did have a small effect upon the response. This finding suggests that the assumption about a direct link between the stated preferred form of depiction and canonical representation needs to be made with caution. However, the strength of preference for oblique projection, partial occlusion and ground plane suggests that the majority of subjects would draw in this manner if they could.

Chapter 8 started with the hypotheses that, firstly, subjects might in some way be prevented from producing a depiction in the way that they think looks most like a table and, secondly, this inability might be overcome by substantial aid with the production of the line drawing. In order to investigate these hypotheses a series of completion tasks were used in which the number and the position of the lines to be completed were varied. Subjects were also asked to draw a table and to choose which depiction, including their own, they thought looked most like a table. It was implicit that the drawing should be done from imagination, although subjects did have line drawings in front of them which they could copy. This design enabled a direct comparison to be made between each subject's completions, production and choice. It was found that, as in the previous chapter, the majority of all subjects preferred a table which was in oblique projection, showing the use of ground plane and partial occlusion, but that subjects tended to complete tables in accordance with their own production despite the degree of help given. This effect was so strong that some subjects deliberately altered the stimulus rather than add the one line required to complete the table in oblique projection. Similarly, some subjects deliberately altered the table legs to give a ground line rather than leave them showing a ground plane. Thus the data presented here supported the first premise but indicated that even with substantial aid subjects showed a reluctance to alter their mode of depiction to accord with their stated preference.

Chapter 9 extended this line of inquiry by examining which aspects of the line drawings presented most problems. This was done by using a series of copying tasks. When subjects were asked to copy line drawings of tables in a variety of different forms of projection the majority of errors produced were elicited by stimuli with a table top in oblique projection and/or showing the use of ground plane and partial occlusion. Even though fewer errors were produced, the pattern of error was similar to that obtained when a table was drawn from imagination. Thus oblique is the form of projection that most subjects prefer, but is also the form of projection that subjects find most difficult to copy. However, very few errors were made when subjects were asked to copy parts of these line drawings without reference to the symbolic content of the depiction. Subjects who were only given parts of the line drawings to copy, but were told what they represented prior to copying, produced the same pattern of errors as was obtained when the whole line drawing was copied. These studies showed that the production difficulties encountered by these subjects were related to the symbolic content of the stimuli and not to figural biases. Finally, it was argued that the error producing aspect of the symbolic content was related to the implicit depth perceived within the stimulus.

B) The relationship between the findings presented in this thesis and the theories of development in the depiction of depth discussed in Chapter 1.

In Chapter 1 it was suggested that theories about development in the depiction of depth could be roughly grouped into four areas, concerned with, respectively: stages in cognition; visual realism; production errors; conceptual/perceptual realism. Little of the work reported in the literature is based on one theory only, and most of it examines a particular aspect of depiction without placing it categorically within the framework of a particular theory. However, a lot of work contains underlying assumptions and it was these assumptions that were examined in the first chapter. This thesis did not set out to test between the alternative theories, however, the main tenets of each of these groups of theories can now be examined in the light of the findings summarised above.

1) Theories involving stages in cognition.

These theories suggest that development occurs by stages linked to the understanding of depth, evidenced by development in the use of a series of projection systems in which linear perspective is the final stage. Piaget (1977) has modified the original very close link between understanding of depth and use of projection systems by suggesting that some subjects, whilst in the stage of formal operations, might not use perspective because they lacked experience in depiction. However, his description still assumes that if a subject does use a projection system it is because the theoretical implications of that system have been understood, and so if subjects do use linear perspective he would expect them to use it correctly. The findings presented in Chapters 3, 4, 5 and 6 are incompatible with all of these suggestions.

Firstly, although linear perspective was used by the majority of older subjects when drawing a table from observation, it was not used correctly. That is, subjects did not show a full understanding of how to use it, but used aspects of it without incorporating these aspects into a single system.

Secondly, the results reported in Chapter 5 showed that the use of oblique projection rather than perspective does not show a less developed understanding of how to depict depth, but reflects the task constraints. Similarly, the age profiles of the proportions of subjects using orthographic and vertical oblique projection overlap to a large extent on all the tasks, which does not offer support for the suggestion that their use is directly related to separate stages in the understanding of depth.

These findings show that development in the representation of depth is not directly linked to development in the understanding of depth itself: stages of development are not directly linked to the use of increasingly complex projection systems, and when linear perspective is used it is not necessarily 'understood'.

2) Theories involving visual realism.

These theories also suggest that development occurs in cognitive stages, but related to the understanding of how to depict depth, rather than the understanding of depth itself. The stages are linked to development away from the use of an object centred method of depiction and towards view specific depiction. These suggestions are also incompatible with the findings presented here.

Chapter 2 illustrated that view specific depiction, or drawing what we 'see', entails the use of perspective (be it linear, oblique, hyperbolic etc.). When oblique projection is used a view centred, rather than a view specific, depiction is produced. It has been shown in Chapters 5, 6, 7 and 8 that linear perspective is only produced when the task constraints emphasise its importance and that oblique projection appears to be used as a default system even by older subjects. For example, either oblique or perspective responses could have been made to some of the stimuli in the completion tasks reported in Chapter 8, yet the vast majority of older subjects used oblique projection. Similarly, a strong preference for tables depicted in oblique projection was shown by all age groups and across a variety of tasks, as reported in Chapters 7 and 8.

Although most of the studies reported in this thesis have required subjects to represent only a single object, it has also been demonstrated that the preference for view centred depictions is not a product of this task constraint. For example, in Chapter 5 subjects were asked to represent a table within a scene, depicting it both from observation and from imagination. In Chapter 7 subjects were asked to choose a line drawing of a table that was depicted against a background in perspective. Finally, also in Chapter 7, subjects were asked to choose which of a number of line drawings of tables looked most like a real table that was placed in front of them.

In conclusion, the data presented in this thesis do not support the idea of development towards view specific depiction. Instead they suggest that the predominant preference for, and use of, oblique projection arises from the drawer's preoccupation with object centred/object informative portrayal and that view specific depiction is only used when it is perceived to be necessary. Without such task constraints even older subjects would normally use oblique projection.

3) Production error theories.

These theories suggest that development in the depiction of depth reflects the child's gradual resolution of production difficulties that are unrelated to the understanding of how to organise and depict depth. If we take a limited view of production errors as figural biases then this view is not supported by the findings presented in Chapter 9, in which it was shown that simple figural biases could not account for the level of error produced. However, it is possible to take a broader view of production errors as reflecting the gradual acquisition of a skilled behaviour that is influenced by general cognitive development. That is, the ability to plan and organise the process of depiction develops, irrespective of the way in which depth is depicted. Chapter 9 lends support to this wider view of production errors. The development in the ability to depict a table in oblique projection found when drawing from imagination was similar to that found when a line drawing was copied. However, this development was shown to occur at an earlier age in the latter task. The copying of a line drawing involves less planning than is needed when drawing an object from imagination. With fewer planning problems the ability to depict depth is enhanced. This indicates that production difficulties, within the wider definition, do have an effect upon the depiction of depth that is not directly related to development in the understanding of how implicit depth within a stimulus can be represented in two dimensions.

In Chapter 1 it was suggested that children use graphic motor schemata as formulae for depicting objects, and that these are used as a method for reducing cognitive load. In Chapter 2 it was suggested that subjects might rely on these formulae to such an extent that they use them inappropriately, and that it was only with experience that subjects developed a wider range of formulae tailored to coping with differing task demands. The findings presented here do suggest that subjects become 'rule bound'. On an individual level Chapter 8 showed that some subjects went to great lengths to alter the stimulus to accord with the way in which they normally depicted a table, even though the stimulus was then altered away from the form that they thought looked most like a table. On a more general level the analyses reported in Chapter 6 showed that whilst development in the use of each depth cue might be gradual, there are strong age related correlations between forms of depiction and these give the appearance of a stage like development. This study was not longitudinal, and therefore it cannot be concluded that a single child's depictions would develop along these lines. However, the data indicated that there were areas of transition in which some parts of the depiction would be represented in a way that anticipated a later form of depiction. This brings to mind the description of development in graphic motor schemata that suggests that new rules are incorporated as they are found to be appropriate.

In conclusion, the findings presented here indicate that all error cannot be attributed to production difficulties, but that such difficulties do play a part in the subject's inability to represent the table in the way that he or she would wish to.

4) Conceptual/perceptual realism theories.

These theories suggest, firstly, that development occurs in the knowledge of how to represent the salient aspects of a three dimensional stimulus (regardless of whether the third dimension is real or inferred) in a two dimensional depiction, and, secondly, that the end point of development can be view centred or view specific depending upon the task constraints. The second of these has already been discussed at length, and has been shown to be supported by the data presented here.

Support for the first of these can be found in a number of the studies reported here. Chapters 7 and 8 showed that even very young subjects thought that the best depiction of a table was one in oblique projection, showing the use of ground plane and partial occlusion, yet even with a great deal of help they found such a depiction difficult to produce. Chapter 9 showed that it was the symbolic element of the stimulus that elicited errors in copying line drawings of tables, and it was argued that the error producing aspect of this was related to the implicit depth perceived within the stimulus.

The object centred nature of our cognitive processes results in the high saliency of occlusion as a perceptual depth cue. The proportions of subjects using occlusion shows a gradual increase with age, and no significant differences have been found in this across the various tasks reported here. These findings are not specific just to the tasks given here, as shown by the significant correlation between these findings and those of Cox (1981), who examined development in the use of occlusion when the relationship between two objects placed one behind the other was depicted (as reported in Chapter 4).

The data presented here support this general approach as presented in Chapter 1, and it forms part of the basis for the model suggested in the following chapter.

General conclusions.

The findings presented in this thesis suggest that a combination of the last two types of theories best explain development in the way in which depth is depicted when a table is drawn. Development has been found to occur in the knowledge of how to represent the salient aspects of a three dimensional stimulus (regardless of whether the third dimension is real or inferred) in a two dimensional depiction. This has been shown to involve the ability to overcome the object centred nature of the relevant cognitive processes. The depiction of depth cues appears to be the underlying factor that develops. The most common end point of development is view centred and in oblique projection. From about the age of ten, subjects attempt to produce view specific depictions if this is perceived to be the appropriate response, but do not do so correctly. The depiction of depth is aided if the amount of planning required by the task is reduced, but production difficulties do not account for all errors. Finally it has been suggested that the data support the idea that subjects used, and were sometimes bound by, graphic motor schemata, and that the use of these schemata might contribute to the appearance of stage like development.

The merits of both groups of theories have been considered on an individual basis, producing a rather disjointed account of what actually happens. The following chapter attempts to knit the strands together and so provide a coherent model of such development.

CONTENTS OF CHAPTER 11.

Development in the Depiction of Depth.

Chapter 11.

Development in the Depiction of Depth.

This chapter examines the processes that are involved in the depiction of depth in the drawing of a table and presents a tentative model of these processes which is based upon the findings and conclusions summarised in the previous chapter. The model is applicable to the restricted task of depicting depth in the drawing a table. However, some aspects of drawing where the model may have wider applicability but which have not been covered directly in this thesis will also be discussed.

Performance has been shown to be related to the task demands and to the level of symbolic content that has been attributed to the stimulus. Development has been shown to occur in the use of depth cues and in the subject's willingness, under certain circumstances, to accept the need for view specificity. These are, however, very general findings. In order to produce some coherence and to add structure to these findings it is first necessary to analyse the process of depicting a table. Once this has been clarified we can then use this structure to aid our examination of how the depiction of depth develops.

A process model has been designed to describe and separate out the processes of depiction that have been found in this thesis. The first part of the chapter concentrates upon explaining the model and examining the routes through it in relation to the findings presented earlier. This suggests that the processes of depiction are interdependent, but have clearly defined roles. The second part of the chapter focusses upon development in the depiction of depth. The use of the process model enables other aspects of development in depiction to be identified, because development in each of the different aspects of depiction, shown in this thesis, can be allocated to different categories within the process model. Hence development in the depiction of depth can be isolated and examined in its own right.

A) THE PROCESS OF DEPICTION.

Figure 11:1 illustrates the process model discussed above. The box labelled 'perception of task demands' represents all task demands as perceived by the subject, both stated and unstated. For example, the subject might be asked to draw the table in front of her, but she might also be aware that if she wants to get to lunch on time she had better draw it quickly. 'Perception of task demands' also includes the initiation of the generation of internal 'stimuli', as for example when a subject is asked to imagine a table. That labelled 'stimulus' represents all forms of external stimuli that the subject might be presented with. The perception of the stimulus is seen to be separate from the stimulus itself. Aspects of perception that are particularly relevant here are those relating to the object centred nature of perception; thus each object within the stimulus is perceived as separate and as having implicit depth. Similarly, implicit depth is perceived in the spatial relationships between the symbolic elements of the stimulus.

THE FORMATION OF GENERAL GOALS.

The box labelled 'conceptualisation of the task' indicates a decision-making area. Conceptualisation is normally seen to be an object centred process, in which consideration of how to depict an object involves imbuing it with implicit depth, and might involve invoking the canonical representation of the object. It is here that general goals of depiction are formed. Such goals can include those of artistic intent, such as: Is the depiction to be visually realistic? Is it to be an expression of

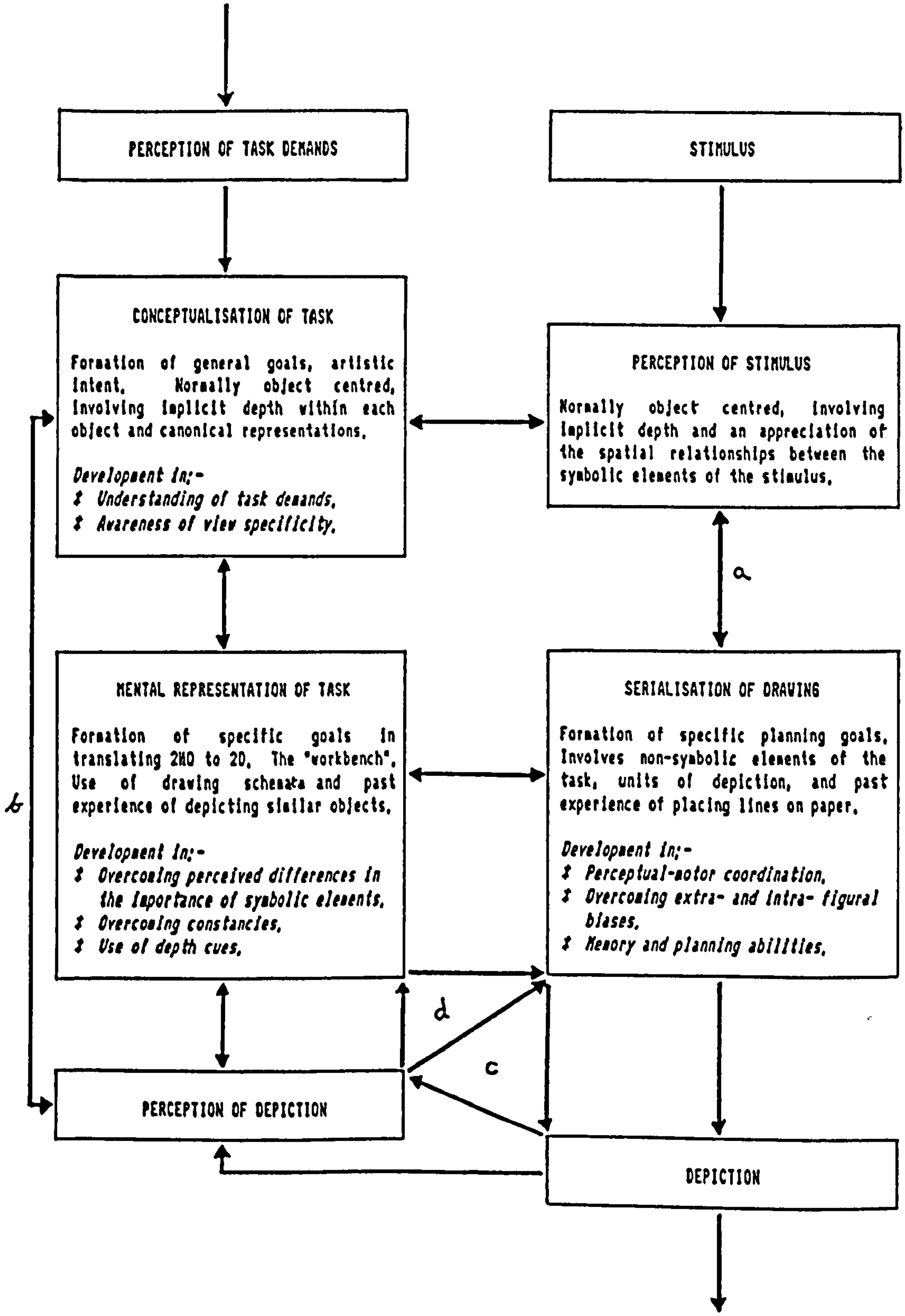

Figure 11:1. *A model of the processes followed when drawing a table. Please see text for details of annotations.*

understanding? Is it to engender feelings in the observer? Is it to be balanced? Is it to be an abstract exploration of lines and colours? Is it to display a particular message? Such goals are based upon the way in which both the task demands and the stimulus are perceived.

In order to clarify this let us examine the routes that some of the subjects might have taken. Initially, let us assume that a subject is asked to draw a table from observation. The subject is aware that the demands of the task are that she should depict the table that is in front of her. Her perception of the stimulus may be affected by the way in which she has understood (conceptualised) the task demands. It can be seen that in this model a degree of variability has been introduced into the task before the subject has considered the mechanics of putting pencil to paper. The subject can interpret the task demands in many different ways, and from this many different general goals or strategies for the execution of the task can be formed. She might focus on the words 'draw' and 'table' and ignore the rest. In this case she will decide to 'draw a table' and although she might look at the stimulus briefly, she might well rely on her knowledge of tables, and therefore possibly use her canonical representation of a table as a source for her depiction. Alternatively, she might be aware of the need to draw a table, but also be aware of the need for visual realism, and decide to attempt this. She might decide to look carefully at the stimulus, but, under these circumstances, her perception of the stimulus is most likely to be object centred and not actually visually realistic. If she is highly skilled she might initially perceive the stimulus in an object centred way, but might make a conscious decision to concentrate on the patterns of outline and light and shade presented by the stimulus. Another option is that she might feel that she cannot draw, and reject the task entirely, or she might be aware of unstated task constraints, such as lack of time, and determine to produce a basic minimum response.

Task demands.

This indicates that there are a variety of task demands, both stated and unstated, that affect the way in which the task is understood and the general goals are formed. The object centred nature of the perception of the stimulus and the conceptualisation of the task implies that the subject will normally have to make a deliberate decision about how to approach the task if she does not wish to produce an object centred depiction.

The way in which the task is conceived can affect the perception of the stimulus. The subject might choose which aspects of the stimulus to which she wishes to pay attention. Similarly the way in which the stimulus is perceived might affect the conceptualisation of the task. On attending to particular aspects of the stimulus the subject might find that the task, as it has been interpreted, is inappropriate and therefore she might redefine the task.

Similar processes might occur in all the tasks presented in this thesis. When a subject is asked to draw a table from imagination there is no 'real' stimulus to perceive and so the need to imagine the stimulus is implicit in the task demands. This does not necessarily imply that she constructs a visual image of the table. She might try to do so if she feels that an attempt at visual realism is implicit in the task demands. However she might infer that the task demands require her to depict what she knows about 'tableness', and so she might incorporate aspects of her canonical representation of a table.

When a subject is asked to copy a line drawing of a table, or to complete a line drawing of a table, her perception of the stimulus will normally be object centred. She will see a 'table'. She might well interpret the task demands as requiring her to depict this 'tableness' in some way. Thus although she has been presented with a two dimensional stimulus it is possible that when conceptualising the task she calls into play the same sorts of attributes (solidity, spatial relationship of symbolic elements, canonical representation, shape, size, and so on) as she would when drawing from observation or imagination.

Chapter 9 showed that subjects have little difficulty in copying lines that are not seen to be symbolic elements of a table. It was argued that in this case perception of the stimulus did not trigger the idea of tableness, nor involve implicit depth. It is possible that under these circumstances that the subject's conceptualisation of the task is very basic. Once the subject has formed the general goal of getting what is in front of her onto the paper, it is probable that the majority of decisions she has to make will occur in 'serialisation of drawing'.

Route 'a'.

The route between perception of stimulus and serialisation of drawing is marked 'a' in the process model. It is possible that this is also the path taken by skilled artists when drawing from observation. Skilled artists who were interviewed for this thesis report being able to look at an object and perceive it without apparent depth or meaning, but as a collection of contours and shapes with areas of contrast, colour and shade. When such artists draw from imagination they report the need to form the fundamentals of the scene into a clear image in their mind before depicting it. If this is the case it lends support to the idea that at times during the depiction a skilled artist acts almost as a transcriber. This is not to say that such an artist 'copies' her image. She is still making decisions. For example, even linear perspective is not totally visually realistic. She has to decide if she wants to approach visual realism and if so what is the best method of indicating this. In real life a colour gradient might be very gradual, yet it cannot be represented in this way: to indicate depth it might be better to blurr the background in a visually unrealistic way. What it does imply is that such an artist has evolved her skill to such an extent that, once she has conceptualised her task and formed general goals, she can sidestep the problems of translating implicit depth in the stimulus and can perceive the aspects of the stimulus that she is concentrating on in a two dimensional way. It is only when she wants to make a decision about the nature of the task that she re-conceptualises it.

It is interesting to speculate that the processes that Nadia used when drawing (discussed in more detail in Chapter 9) also followed this route. Her drawing skill appeared to be related to highly developed perceptual ability, at the expense of conceptual ability (Selfe 1977). As she gradually acquired the ability to use more than a few words, so her drawing ability declined. Selfe (1985) suggests that "autistic subjects (with anomalous drawing ability) appear to be attending to non-symbolic aspects of visual experience. Objects are truncated or partially occluded and represented without their defining characteristics, as seen from one fixed viewpoint. This type of drawing is necessarily autistic and asocial in so far as one single viewpoint is possible only to one single viewer at a fixed spot. It is therefore hypothesised that the autistic child, in drawing, records objects in his optic array more as patterns - edges, contours and shapes - rather than representatives of classes or symbols." The converse of this is that it is the normal child's object centred conceptualisation of the task that interferes with his ability to depict depth in a manner approaching visual realism.

Redefining the task, route 'b'.

When considering task demands and the formation of general goals within the conceptualisation of the task it would be unwise to assume that the subject develops an idea of what he or she is going to produce and then attempts to 'copy' it. The subject may well re-define the task several times as the depiction progresses. All the following senarios were observed during the collection of data for this thesis. One young boy started to draw a table, but felt that his partial depiction looked more like a house, and so he re-defined the task into one of house drawing. A teenager started to draw a table from observation but enjoyed the process so much that she redefined the task to include the whole scene. A fifty three year old wanted to draw the table as she saw it (from centre front) but drew the table top as a square. After several tries she gave up and said that although it did not look like that she was going to draw a plan view. Thus the distinction between conceptualisation of task and mental representation (the workbench) might be quite blurred, as might that between mental representation and perception of depiction. In this way perception of depiction can be seen to have an effect upon the way in which the task is conceived, and vice versa (route b in the model).

Implicit depth.

The findings reported in Chapter 7 are perhaps the closest indication of the way in which most subjects conceive the depiction of a table. The preferred form of table is affected by the task demands, but in general the majority of subjects preferred a table in oblique projection, showing the use of partial occlusion and ground plane, thus preferring a view centred rather than a view specific depiction. It was suggested that this form of depiction is the two-dimensional representation closest to the canonical representation, with its implicit depth, that most subjects have of a table. The virtue of this form of representation is that it preserves to a certain degree the cuboid shape of a table, and the spatial relationship of the symbolic elements of the table, whilst also implying depth.

It has been suggested that when we identify an object, whether we perceive it, think about it, or try and build a mental representation of it, each symbolic element can be perceived as separate and as having implicit depth. However, we have to ignore the symbolic nature of the elements in order to make a visually realistic depiction of the object. The existance of shape constancy means that, regardless of the form in which we see the object, there are attributes that we perceive as part of the nature of the object (such as the handle on a cup). The operation of size constancy means that we perceive the object to be approximately the same size however far away it is. Not only do children have to overcome this in order to draw in a view centred way, but they also have to overcome the urge to exaggerate the size of the elements of objects that they perceive as having greater symbolic importance than other elements. Similarly it is necessary to overcome colour and texture constancies in order to be able to use these as depth cues. Therefore the subject's final production depends, partially, upon her ability to overcome the effects of perceptual constancies, the desire for separateness, and perceived differences in the importance of the symbolic elements.

Mental representation of the task is the decision making area in which these problems are addressed. It incorporates the idea of a mental 'workbench' in which the subject forms specific goals about how to translate the symbolic elements of the conceived depiction (with their implicit depth and spatial relationships to each other) into two dimensional reality. If the subject is quite skilled, or the object to be depicted is quite simple, it is feasible that the subject could construct quite a clear mental representation of exactly what she wants to depict and of how it is to be done. Thus, in this case, conceptualising the task and forming a mental representation of how to proceed are part of the same process. However, if this is not the case, the model suggests that a series of sub-goals will be formed and, on completion of each sub-goal, decisions will be made with reference to the general goal and the state of the depiction itself: whether to continue as planned or to re-define the remaining sub-goals or to form new ones.

THE FORMATION OF SUB-GOALS.

The use of drawing schemata can be seen as part of this process. The subject might have a highly developed scheme for depicting a particular type of symbolic element. If he then sees the need to depict that element he might utilise the scheme, whether or not it is actually appropriate. For example, if a young child is asked to draw a table from observation and has a clear idea of how he draws tables he might call this into play even though the resulting depiction does not resemble the table in front of him. Alternatively he might start to draw the table in front of him, but find that when he gets to areas of difficulty the way in which he perceives the depiction suggests solutions he has used previously. He knows they will not look exactly as he wants them to, but as he has used them to solve similar problems he believes that they are the best solution. This sort of behaviour was illustrated in Chapter 8 where subjects were asked to complete drawings of tables. The completion task removed potential problems related to the serialisation of the drawing, but some subjects at all ages deliberately altered parts of the stimuli to make them similar to their own form of production, even though this did not necessarily accord with their preferred form of depiction.

It is necessary to make a distinction between drawing rules related to the planning of the depiction, such as 'always draw the whole shapes first', and rules relating to more conceptual problems of depicting the object in a view centred way. For example, a rule might be 'always draw the front face first to avoid the need for hidden line elimination'. The distinction between the two is that the former concentrates on the process of getting the lines on the paper, irrespective of any symbolism the lines might have, whilst the latter concentrates upon transforming the perceived symbolism into a depictable form. Although drawing schemata can encompass both sorts of rules, the rules are derived from different parts of the model. Rules that are developed to cope with the symbolic element of the task relate to the mental representation of the task, whilst rules developed to cope with non-symbolic elements of the task relate to the serialisation of the drawing.

Serialisation of drawing.

Serialisation of drawing involves the formation of specific planning goals and the drawing rules related to the planning of the depiction. Thus errors that occur irrespective of the symbolic nature of the task are attributable to this aspect of the process of depiction. This was examined in Chapter 9, where it was found that very few such errors occurred in the simple tasks given there. The incidence of such errors is, however, widely documented (see Freeman and Cox, Eds., 1985 for detailed analyses) and it is worth extending the discussion to include these if the model is to be seen to have relevance to other forms of depiction.

Serialisation of drawing assumes that the subject has a clear mental image of what he wants to put upon the paper. In the case of the skilled artist drawing from observation, discussed earlier in the chapter, he might only want to put a couple of lines on the paper, the position of which he has just examined and memorised. If he is drawing from imagination it might be a whole series of lines representing a section of the imagined scene that he has analysed and planned how to depict. In the case of a young child it might be that he is employing a familiar drawing scheme and he has little planning to do and follows a well worn routine. Alternatively, he might have been asked to copy two lines joining at an angle. He might try to construct a visual image of them and get both on paper without looking back at the stimulus, or he might carefully copy one and then work out where the other should go. The unit of depiction that is involved can vary from one line to a whole series of lines, but in each case the emphasis is upon memory, planning, and the correct placement of lines. The size of the unit is seen to be related to the complexity of task and the level of skill of the drawer.

Feedback loop 'c'.

Involved in this process is the small feedback loop, marked c in the model. This is the area in which the depiction of the units is executed and the mechanical control of the units is monitored. Errors can occur both in the execution of the unit and in the way in which it is monitored. For example, if the child is attempting to copy two lines joining at an angle he might have poor perceptual-motor coordination, and therefore not place the lines as he wishes, or he might fall prey to an extra- or intra- figural bias. He might appreciate the error and try to correct it, or the error might originate from the way in which he initially perceived the stimulus and hence he might not perceive the depiction to be erroneous. Therefore the final production is related to perceptual-motor coordination and the ability to overcome extra- and intra- figural biases, whether they originate from the perception of the stimulus, the process of depiction, or a combination of the two.

Feedback loop 'd'.

The second feedback loop, marked d in the model, indicates the route that the subject normally adopts on the completion of each unit. For example, when drawing from observation she may initially have planned how to draw the table top, decided to draw it as a square, and have executed that. The table legs were not included in her initial unit of depiction and she now needs to decide how she is going to draw them. She refers back to her mental representation of the task and decides that the front legs extend from the two front corners directly to the ground. This is moderately easy to plan and so she executes this in one unit, travelling through route c several times. She then needs to draw the back legs. She might have a clear idea of how she normally copes with the problem of showing them behind the others, and so she executes this, travelling several times through route c, and finishing her depiction. Alternatively, she might know how she would like it to look, but does not know how to achieve this. She has gone through route d again to her mental representation of the task. She might alight upon a solution and so return to serialising the drawing. Alternatively, she might return to her conceptualisation of the task, review the task demands, or even have another look at the stimulus before deciding on what to do and travelling through loops c and d (possibly several times) and finishing the depiction.

This description of a route through the model highlights the fact that depiction is not a single process in which the stimulus is examined and then copied onto paper. The process of depiction is one requiring many decisions at different levels. The model emphasises the cyclical nature of depiction, and the frequency with which skilled depictors check on the progress of the depiction. Failure to make the 'correct' decision at any part of the process will influence later decisions, and affect the final depiction.

B) DEVELOPMENT IN DEPICTION.

The model has allowed us to separate out the various processes involved in depiction. Having done this, we are now able to examine the development in depiction that has been shown in this thesis by allocating it to various categories. Three main areas of development can be identified: development related to conceptualisation of the task; mental representation of the task; serialisation of drawing. We are assuming that development of perception also occurs, but this is not addressed by the model which is specifically identifying development in the drawing process.

Development related to conceptualisation of the task.

Development related to conceptualisation of the task refers to development associated with increased ability to understand task demands and to form general goals that concur with the task demands. In Chapter 7 it was shown that the majority of subjects preferred a table in oblique projection, showing the use of partial occlusion and ground plane, thus preferring a view centred rather than a view specific description.

The preference for this form of representation remained strong across all ages and both Chapters 5 and 7 showed that the majority of children younger than ten years of age did not modify their performance if the task demands emphasised visual realism. In contradiction to this, as discussed in detail in Chapters 1 and 2, many researchers have found that very young children are able to modify their depictions in relation to the task demands. It may be possible to reconcile these two points. Barrett *et al* (1985) suggest that "the acquisition of the flexibility which characterises the drawing behaviour of older children should be attributed, at least in part, to the acquisition of a greater sensitivity to the variable task demands which can be implied by different verbal instructions, and not solely to the acquisition of additional drawing devices for depicting objects in depth." The studies that showed young children's sensitivity to task demands all placed strong emphasis upon their appreciation of the need for view centred depictions, thus possibly increasing the salience of this aspect of the task. The studies reported here did not explicitly emphasise visual realism. When subjects were asked to draw a table from observation they were asked to draw a particular table but they were not primed to observe the table closely, to identify exactly what they could or could not see, or to explore the exact outline of the table. Similarly, when subjects were asked to identify the depiction that looked most like the table placed in front of them they were not asked to analyse exactly how that table looked. It could be argued that an awareness of the salience of visual realism occurs 'naturally' from about ten years of age, but that individual aspects of this, such as height in the picture plane or partial occlusion, might be elicited at an earlier age if the need for them is perceived in the task demands.

The model identifies one potential area of development in the manner in which the task demands are interpreted. It suggests that young children are normally insensitive to the need for a view centred depiction, although they prefer it and can produce aspects of it if the task demands make it salient. From about the age of ten, subjects begin to show (under certain circumstances) increased awareness of specificity of viewpoint. This does not, however, translate itself directly into their depictions. Their drawings become more view centred, but a specific viewpoint (linear perspective) is only attempted or chosen when it is seen to be a necessary part of the task.

Development related to mental representation of the task.

The second main area of development is that associated with mental representation of the task. It is here that the model suggests that we form goals about translating the depth implicit within our conceptualisation of the task into two dimensions. To be effective we have to overcome the effects of perceptual constancies, the desire for separateness and perceived differences in the importance of the symbolic elements, and draw in such a way that others can infer three dimensionality from the depiction. Pictorial depth cues, which were shown earlier to be linked to the way in which we perceive objects in the visual scene, are the most effective representational devices to use. It follows from this that the ability to use depth cues correctly is linked directly to the ability to depict implicit depth within objects and to the ability to overcome the effects of perceptual constancies.

The relationship between overcoming perceptual constancies and the use of depth cues is an important one. The object centred nature of our cognitive processes renders occlusion highly salient as a perceptual depth cue, yet in order to use it as a pictorial depth cue we have to accept shared and disrupted boundaries. The strong correlations found between a wide variety of tasks (both in studies reported in this thesis and in other studies) in the gradual increase, with age, in the proportions of subjects using occlusion indicates the strength and importance of the relationship between the use of occlusion and development in depiction.

Height in the picture plane can be seen as a precursor to the use of occlusion when it is used in the depiction of two or more objects. It maintains the object centred nature of the depiction whilst, in an approximate way, indicating the relative positions of the objects to the viewer. It can be argued that the same thing happens when it is used in the depiction of a single object. The drawer is indicating that some parts of the object are further from the viewer than other parts. The use of height in the picture plane within a single object presents the drawer with the problem of indicating the relationship between the parts of the object, which leads to shape constancy being compromised. As was explained in Chapter 2, the use of a table as a single stimulus object should provide fewer such problems than would the use of other stimuli. Unfortunately, because it is an atypical stimulus in this respect, we cannot assume that the results found here are directly applicable to the depiction of other stimuli. Similarly it is difficult to make comparisons between findings presented in this thesis and those of other studies in which the use of height in the picture plane has co-varied with the use of other depth cues. However, throughout this thesis the proportions of subjects use ground plane have been shown to increase gradually with age, and in Chapter 6 it was demonstrated that, in the drawing of a table, the use of ground plane develops before the use of occlusion. Therefore the findings presented in this thesis suggest the need for further research into the use of height in the picture plane as a depth cue in its own right.

The perception and recognition of an object invokes the use of size, colour and texture constancies, yet a visually realistic depiction of such an object within a scene requires the ability to overcome such constancies and use the depth cues of diminishing size with distance and texture and colour gradients. These depth cues can all be applied in a view centred rather than a view specific way. For example, objects in the distance can be represented as smaller than those nearby, without necessarily specifying the viewpoint. These depth cues can also be used in the depiction of a single object, and, if diminishing size with distance is used consistently within an object, it can indicate a specific view point. However, in Chapter 3 it was shown that, whilst an increasing number of subjects, with age, used diminishing size with distance in the depiction of the table top, it was not used when the table legs were depicted. Thus subjects who were using it did so in a view centred rather than a view specific way.

These findings suggest that within the subject population development in the use of each individual depth cue is gradual and involves a shift away from an object centred depiction to a view centred depiction. Therefore, whilst even very young subjects prefer depictions that use pictorial depth cues, they do not use them themselves because they are constrained by the object centred nature of their cognitive processes. Development in the use of depth cues reflects the learning of methods by which implicit depth can be represented in two dimensions.

It can be argued that there is a continuum between view centred and view specific depiction, in that within a scene the greater the number of depth cues used in conjunction with each other the greater the degree of view specificity. However, as has been shown repeatedly in this thesis, adults generally use a combination of occlusion and height in the picture plane to produce a depiction in oblique projection that they are happy with and believe satisfies the requirement of an accurate depiction of an object. It is only when they perceive the need for a view specific depiction that they also attempt to use the depth cue of diminishing size with distance. The findings presented above show how difficult a cue this is to use within the depiction of a single object. Thus, when it was salient to the task demands, subjects from about ten years old showed increasing sensitivity to view specific task constraints and produced a greater degree of view specificity within their depictions, although correct view specificity was never produced.

Development in each of the above depth cues has been found to occur across the subject population in a gradual manner. However it was suggested in the last chapter that development in drawing schemata might occur in a stage-like way for each individual subject. Part of the problem of determining exactly what happens is the difficulty of separating ability from performance. For example, the child might be able to use occlusion, but not normally see the need for it. She might be 'hooked' into a particular form of drawing scheme that does not include the use of occlusion, and it is only as she is forced to abandon that particular scheme, or to develop a wider range of schemes, that she gradually incorporates occlusion into the way she normally draws. Alternatively she might appreciate that occlusion is a useful general rule, and she might decide to apply it wherever possible. Therefore it is quite probable that the ability to use one particular depth cue develops in a stage-like way, but that the frequency with which each subject uses it increases gradually with age, experience, and the complexity of the depiction. These speculations cannot be addressed in this thesis because no longitudinal data were obtained but they do emphasise the need for such investigations.

A variety of groups of table drawings were identified in Chapter 6 and it was suggested that development between these groups might occur by the additive use of depth cues in the depiction of the symbolic elements of the table. It is worth examining ways in which this might occur. The subject might make an error when serialising the drawing but perceive that the depiction now accords more closely with the intended form of representation. The same process might occur if she attempts to draw a new object. She cannot rely on one particular drawing scheme and so she is forced either to look at the object closely, to combine parts of different drawing schemata, or to plan the depiction carefully and to construct new solutions. In each of these cases she might incorporate the mode of action into the drawing scheme for that particular object. However, if she appreciates the significance of what she has learnt she might try to remember it as a general rule of depiction, that is, as another tool to be placed beside her workbench.

A further source of learning might be external. The subject might have been actively 'taught' how to use a particular depth cue, or he might have deliberately observed how other people cope with the same problem. Chapter 5 showed that the teaching of the rules of linear perspective is not a particularly effective method of encouraging view specificity. An interesting line of research would be to investigate the effects of tuition of young children in the use of individual depth cues and their importance for a view centred depiction.

Development related to serialisation of drawing.

The third main area of development is that related to the serialisation of drawing. The focus of attention here is on specific planning goals involving the non-symbolic elements of the task. Development occurs in perceptual-motor co-ordination and in the ability to overcome extra- and intra- figural biases. This development is related to that of memory and planning abilities. Development in perceptual-motor coordination could be purely physiological, involving, for example, the ability to put a line where you want it to go, or it could be partly related to planning, knowing exactly where you want the line to go in the first place. For example, Rand (1973) showed that accuracy is improved if children are taught to mark the end points before they draw lines. Similarly, the young child's lack of ability to overcome extra- and intra- figural biases might be perceptual, in that she might perceive the stimulus in a biased way and so not appreciate the error introduced into her depiction. However, this lack of ability might also be related to planning problems. If she forms a general rule to draw one side of the object the same as the other (symmetry) her cognitive load will be reduced, and she will also find symmetrical objects easier to draw than others. In this case the symmetry would not be an artistic desire for balance, but a method of reducing cognitive load. Other general rules to reduce cognitive load might be 'always use the sides of the paper as a guide when drawing vertical lines', or 'always draw the angle where lines meet as a right angle'. These rules are perfectly adequate for most of the spontaneous depictions that young children produce.

The model indicates that the rules made by the child only become inadequate when the task demands specify a form of depiction that is not covered by them. In this case the form of the final depiction is partially a function of the child's ability to handle the increased cognitive load necessitated by the abandonment of the rules, the perceived importance of the unwelcome task demands, and the ability to develop other coping strategies. For example, in Chapter 9 it was found that very little error occurred when young children were asked to copy diamond shapes. This is at variance with the findings of Naeli and Harris (1976), who placed the development of this ability at a greater age. It is possible that the task demands presented in Chapter 9 were sufficient to enforce the abandonment of inapplicable rules of depiction and to highlight the need for extra cognitive load. Presumably those subjects who felt unable to handle the extra cognitive load would employ inflexible drawing strategies.

Part of the stage-like nature of a child's development in depiction could be attributed to the way in which development occurs in the rules of depiction upon which drawing schemata are based. It follows that the arguments presented above about development in drawing schemata also relate to the non-symbolic aspects of drawing schemata. In order to reduce cognitive load subjects might develop rules about how particular clusters of lines should be placed upon the paper. These rules might normally serve their purpose well, but could be inappropriate to certain task demands.

As the child's ability at general cognitive processing develops, so he is able to develop a wider range of strategies for dealing with planning problems. Development occurs in the necessary problem solving skills, in particular those related to memory and planning. Past experience of placing lines on paper will enable the subject to gauge more accurately the size and complexity of unit he is capable of depicting accurately, and the circumstances under which he needs to check his progress. Experience will also enable him to gauge the effectiveness of general planning rules that he might develop and will enable him to extend his repertoire of such rules. This view of the serialisation of the task assumes that each subject can only cope with a particular level of cognitive load, and leads to the supposition that development can be aided by explicit tuition in methods of reducing cognitive load.

Conclusions.

This chapter has presented a model of the processes involved when a table is depicted. The model may be applicable to other forms of depiction, but the reason the model is presented here is to enable the processes involved to be categorised and so to isolate the different forms of development that have been shown in this thesis. The model has shown that there are several factors to take account of when we wish to explain how the depiction of depth develops. The ability to depict depth depends upon the subject's ability to place lines on the paper in the way he or she wishes them to be, upon the ability to use appropriate depth cues, and upon the ability to perceive the need for the depiction of depth and the form that this should take. Each factor plays an important part in the final depiction. The results reported in this thesis show, however, that an analysis of development in terms of the use of depth cues is central to our understanding of the child's progression from an object centred to a view centred depiction.

References.

Allik, J. and Laak, T. (1985) *The head is smaller than the body: But how does it join on?* in Freeman, N. H. and Cox, M. V. (Eds), Visual Order: The nature and development of pictorial representation. Cambridge: Cambridge University Press.

Ames, L. B. and Ilg, F. (1963) *The Gesell incomplete man test as a measure of developmental status.* Genetic Psychology Monographs, 68, 247-307.

Arnheim, R. (1974) *Art and Visual Perception (2nd. Edition).* Berkeley: University of California Press.

Arnheim, R. (1980) *The puzzle of Nadia's drawings.* Arts in Psychotherapy, 7, 79-85.

Avons, S. E. and Phillips, W. (1980) *Visualisation and memorisation as a function of display time and poststimulus processing time.* Journal of Experimental Psychology: Human Learning and Memory, 6, 407-420.

Barnhart, E. N. (1942) *Developmental stages in compositional construction in children's drawings.* Journal of Experimental Education, 11, 156-181

Baron-Cohen, S. (1987) *Autism and symbolic play.* British Journal of Developmental Psychology, 5, 139-148.

Baron-Cohen, S., Leslie, A. M. and Frith, U. (1985) *Does the autistic child have a "theory of mind"?* Cognition, 21, 37-46.

Barrett, M. D. (1983) *The study of children's drawings: Piagetian and experimental approaches.* Early Child Development and Care, 12, 19-28.

Barrett, M. D., Beaumont, A. and Jennett, M. (1983) *The effect of instructions upon the representation of depth in children's drawings.* Paper presented at N.A.T.O. Conference on Intelligence and Learning: University of York.

Barrett, M. D. and Bridson, A. (1983) *The effect of instructions upon childrens drawings.* British Journal of Developmental Psychology, 1, 175-178.

Barrett, M. D., Beaumont, A. V. and Jennett, M. S. (1985) *Some children do sometimes do what they have been told to do: task demands and verbal instructions in children's drawings.* in Freeman, N. and Cox, M. (Eds.), Visual Order: The nature and development of pictorial representation. Cambridge: Cambridge University Press.

Bartly, S. H. (1941) *Vision: A study of its bases.* New York: Van Nostrand.

Bassett, E. (1977) *Production strategies in the child's drawing of the human figure.* in Butterworth, G. E. (Ed), The Child's representation of the World. New York: Plenum Press.

Bayraktar, R. (1985) *Cross-cultural analysis of drawing errors.* in Freeman, N. and Cox, M., (Eds.), Visual Order: The nature and development of pictorial representation. Cambridge: Cambridge University Press

Berman, P. W. (1976) *Young children's use of the frame of reference in construction of the horizontal, vertical, and oblique.* Child Development, 47, 259-263.

Berman, P. W., Cunningham, J. G. and Harkulich, J. (1974) *Construction of the horizontal, vertical and oblique by young children: failure to find the 'oblique' effect.* Child Development, 45, 474-478.

Bornstein, M. H., Ferdinandsen, K. and Gross, C. G. (1981) *Perception of symmetry in infancy.* Developmental Psychology, 17, 82-86.

Boswell, S. L. (1976) *Young children's processing of symmetrical and asymmetrical patterns.* Journal of Experimental Child Psychology, 22, 309-318.

Bower, G. H. (1972) *Mental imagery and associative learning.* in Gregg, L. (Ed), Cognition in Learning and Memory. New York: Wiley.

Bower, T.R.G. (1978) *Perceptual development: object and space.* in Carterette, E. C. and Friedman, M. P. (Eds), Handbook of Perception, Volume 8: Perceptual Coding. Academic Press.

Braine, L. (1978) *A new slant on orientation perception.* American Psychologist, 33, 10-22.

Brainerd, J. and Heuvel, K. V. (1974) *Development of geometric imagery in five to eight year olds.* Genetic Psychology Monographs, 89, 89-143.

Bremner, J. G. (1984) *Errors towards the perpendicular in children's copies of angular figures: a test of the bisection interpretation.* Perception, 13, 117-128.

Bremner, J. G. (1985a) *Provoked use of height in picture as a depth cue in young children's drawings.* British Journal of Developmental Psychology, 3, 95-98.

Bremner, J. G. (1985b) *Figural biases and young children's drawings* in Freeman, N., and Cox, M. (Eds.), Visual Order: The nature and development of pictorial representation. Cambridge: Cambridge University Press

Bremner, J. G. and Moore, S. (1984) *Prior visual inspection and object naming: Two factors that enhance hidden feature inclusion in young children's drawings.* British Journal of Developmental Psychology, 2, 371-376.

Bremner, J. G. and Taylor, A. J. (1984) *Children's errors in copying angles: perpendicular error or bisection error?* Perception, 11, 163-171.

Brooks, M. R., Glenn, S. M. and Crozier, W.R. (1988) *Pre-school children's* *preferences for drawings of a similar complexity to their own.* British Journal of Educational Psychology, 58, 165-171.

Bruner, J., Olver, R. and Greenfield, P. (1966) *Studies in Cognitive Growth.* New York: Wiley.

Bryant, P. E. (1974) *Perception and Understanding in Young Children: an experimental approach.* London: Methuen.

Byrne, R. W. (1979) *Memory for urban geometry.* Quarterly Journal of Experimental Psychology, 31, 147-154.

Chase, W. G. (1983) *Spatial representation in taxi drivers.* in Rogers, D. R. and Sloboda, J. A. (Eds) The Acquisition of Symbolic Skills. New York: Plenum.

Chase, W. G. and Clark, H. H. (1972) *Mental operations in the comparison of sentances and pictures.* in Gregory, L. (Ed.), Cognition in Learning and Memory. New York: Wiley.

Chen, M. J. (1985) *Young children's representational drawings of solid objects: a comparison of drawing and copying.* in Freeman, N. and Cox, M. (Eds.), Visual Order: The nature and development of pictorial representation. Cambridge: Cambridge University Press.

Chen, M. J. and Cook, M. (1984) *Representational drawings of solid objects by young children.* Perception, 13, 377-385.

Chi, M. T. H. (1978) *Knowledge structures and memory development.* in Siegler, R. S. (Ed), Childrens Thinking: What Develops. Lawrence Erlbaum. Hillsdale: New Jersey.

Chipman, S. F. and Mendelson, M. J. (1975) *The development of sensitivity to visual structure.* Journal of Experimental Child Psychology, 20, 411-429.

Cohen, A. J. and Foley, J. E. (1982) *Mental imagery and mental maps.* Paper presented at conference at Keele University.

Cooper, L. A. (1975) *Mental rotation of random two dimensional shapes.* Cognitive Psychology, 7, 20-43.

Cooper, L. A. and Shepard, R. N. (1972) *Cronometric studies of the rotation of mental images.* in Chase, W. G. (Ed), Visual Information Processing. New York: Academic Press.

Costall, A. (1985) *How meaning covers the traces.* in Freeman, N. H. and Cox, M. V. (Eds), Visual Order: The nature and development of pictorial representation. Cambridge: Cambridge University Press.

Cox, M. V. (1981) *One thing behind another: problems of representation in children's drawings.* Educational Psychology, 1, 275-287.

Cox, M. V and Parkin, C. E. (1986) *Young children's human figure drawing: cross sectional and longitudinal studies.* Educational Psuchology, 6, 353-368.

Crook, C. (1983) *Intellectual realism and segregation.* Paper presented at the N.A.T.O. Conference on Intelligence and Learning, University of York.

Crook, C. (1984) *Factors influencing the use of transparency in children's drawing.* British Journal of Developmental Psychology, 2, 213-221.

Crook, C. (1985) *Knowledge and appearance.* in Freeman, N. H. and Cox, M. (Eds), Visual Order: The nature and development of pictorial representation. Cambridge: Cambridge University Press.

Davies, G. and Brown, L. (1978) *Recall and organisation in five year old children.* British Journal of Psychology, 69, 343-349.

Davies, G. and Rushton, A. (1980) *Presentation mode and organisational strategies in young children.* in Friedman, N., Das, J. P. and O'Connor, N. (Eds), Intelligence and Learning. New York: Plenum Press.

Davis, A. (1983) *Contextual sensitivity in young children's drawings.* Journal of Experimental Child Psychology, 35, 478-486.

Deregowski, J. B. (1969) *A pictorial perception paradox.* Acta Psychologica, 31, 365-374.

Deregowski, J. B. (1976) *Coding and drawing of simple geometric stimuli by Bukusu schoolchildren.* Journal of Cross-Cultural Psychology. 7, 195-208

Deregowski, J. B. (1977) *Pictures, symbols, and frames of reference.* in Butterworth, G. E. (Ed), The Childs Representation of the World. New York: Plenum.

Deregowski, J. B. (1978a) *Pictures as a means of communication: a psychologists view.* Educational Broadcasting International, March.

Deregowski, J. B. (1978b) *On reexamining Fortes' data: some implications of drawings made by children who have never drawn before.* Perception, 7, 479-484.

Deregowski, J. B. (1979) *Perception of simple figures: implicit-shape constancy and mental rotation.* British Journal of Psychology, 70, 25-34.

Deregowski, J. B. (1980a) *Experienced and inexperienced model makers.* Journal of Cross Cultural Psychology, 11, 189-202.

Deregowski, J. B. (1980b) *Mental rotation and typical views: a heuristic experiment.* International Journal of Psychology, 15, 83-93.

Deregowski, J. B. (1980c) *Experienced and inexperienced model makers: model making and drawing in Rhodesia.* Journal of Cross Cultural Psychology, 11, 189-202.

Deregowski, J. B. (1986) *Kazimierz Bartel's observations on drawings of children and illiterate adults.* The British Journal of Developmental Psychology, 4, 331-334.

Deregowski, J. B. and Strang, P. (1986) *On the drawing of a cube and its derivatives.* The British Journal of Developmental Psychology, 4, 323-330.

Donaldson, M. and Balfour, G. (1968) *Less is more: a study of early language comprehension.* British Journal of Psychology, 59, 461-471.

Duberry, F. and Willats, J. (1983) *Perspective and other drawing systems.* London: Herbert Press.

Duthie, R. K. (1985) *The adolescent's point of view: studies in forms of conflict.* in Freeman, N. H. and Cox, M. V. (Eds), Visual Order: The Nature and Development of Pictorial Representation. Cambridge: Cambridge University Press.

Eddy, J. K. and Glass, A. L. (1981) *Reading and listening to high and low imagery sentances.* Journal of Verbal Learning and Verbal Behaviour, 20, 333-345.

Edwards, B. (1979) *Drawing with the right side of the brain.* Los Angeles: Tarcher.

Eldred, C. A. (1973) *Judgements of right side up and figure rotation by young children.* Child Development, 44, 395-399.

Elkind, D. (1970) *Developmental studies of figurative perception.* Advances in Child behaviour and Development, 4, 2-29.

Elliot, J. and Connolly, K. J. (1978) *The effect of visual frame of reference on a judgement of plane stimulus orientation by children.* Perception, 7, 139-149.

Farah, M. J. (1988) *Is visual imagery really visual? Overlooked evidence from neuropsychology.* Psychological Review, 95, 307-317.

Farber, J. and Rosinski, R.R. (1978) *Geometric transformations of pictured space.* Perception, 7, 269-282.

Fenson, L. (1985) *The transition from construction to sketching.* in Freeman, N. and Cox, M. (Eds.), Visual Order: The nature and development of pictorial representation. Cambridge: Cambridge University Press.

Finch, D. (1977) *Hyperbolic geometry as an alternative to perspective for constructing drawings of visual space.* Perception, 6, 221-225.

Finke, R. A. and Kosslyn, S. M. (1980) *Mental imagery acuity in the peripheral visual field.* Journal of Experimental Psychology, Human Perception and Performance, 6, 126-139.

Fisher, C. B. and Ferdinandsen, K. Bornstein, M. H. (1981) *The role of symmetry in infant form discrimination.* Child Development, 52, 457-462.

Fisher, G. H. (1974) *An experimental study of linear inclination.* Quarterly Journal of Experimental Psychology, 18, 52-62.

Fisher, R. B. (1982) *A structured pattern matching approach to intermediate* *level vision.* Department of Artificial Intelligence Research Paper 117. University of Edinburgh.

Fisher, R. B. (1986) *Identity independent object segmentation in 2½D sketch data.* Department of Artificial Intelligence Research Paper 285: University of Edinburgh.

Fisher, R. B. (1987) *S M S: A suggestive modelling system for object recognition.* Personal Communication: Proposed chapter in Fisher, R. B., From Surfaces to Objects: Computer Vision and Three Dimensional Scene Analysis. Wiley.

Freeman, N. H. (1972) *Process and product in children's drawing.* Perception, 1, 123-140.

Freeman, N. H. (1976a) *Childrens drawings cognitive aspects.* Journal of Child Psychology and Psychiatry, 17, 345-350.

Freeman, N. H. (1976b) *How Children Draw.* Seminar version of a paper delivered at the British Psychological Society, Annual Conference: Developmental Section: Guildford.

Freeman, N. H. (1977a) *What is the child's own view in a spatial task? : a spatial by temporal interraction affecting errors in perceptual reports.* Perception, 6, 393-398.

Freeman, N. H. (1977b) *How young children try to plan drawings.* in Butterworth, G. (Ed), The Child's Representation of the World. Plenum.

Freeman, N. H. (1980a) *The underlying order in children's drawings.* in Cox, M. (Ed), Are Young Children Egocentric? London: Bartsford Academic.

Freeman, N. H. (1980b) *Strategies of representation in young children: analysis of spatial skills and drawing processes.* London: Academic Press.

Freeman, N. H. (1983) *Picture-plane bias in children's representational drawing.* Australian Journal of Psychology, 35, 121-134.

Freeman, N. H. (1986) *How should a cube be drawn?* British Journal of Developmental Psychology, 4, 317-322

Freeman, N. H. and Janikoun, R. (1972) *Intellectual realism in childrens drawings of a familiar object with distinct features.* Child Development, 43, 1116-1121.

Freeman, N. H., Eiser, C. and Sayers, J. (1977) *Children's strategies in producing three-dimensional relationships on a two-dimensional surface.* Journal of Experimental child Psychology, 23, 305-314.

Freeman, N. H. and Hargreaves, S. (1979) *Directed movements and the body-proportion effect in preschool children's human figure drawing.* Quarterly Journal of Experimental Psychology, 29, 227-235.

Freeman, N. H. and Hayton, C. (1980) *Gross failure to utilise alignment cues in children's drawing of three-dimensional relationships.* Perception, 9, 353-359.

Freeman, N. H. and Kelham, S. E. (1981) *The interference of a baseline with children's orientation judgement need not entirely mask their contextual responsiveness.* Quarterly Journal of Experimental Psychology, 33A, 145-154.

Freeman, N. H., Chen, M. J. and Hambly, M. (1984) *Children's different use of alighnment cues when encoding and when producing a match-to-target.* British Journal of Developmental Psychology, 2. 123-138.

Freeman, N. H. and Cox, M. (1985) *Visual Order: The nature and development of pictorial representation.* Cambridge University Press

Friedman, S. and Stevenson, (1975) *Developmental changes in the understanding of implied motion in two-dimensional pictures.* Child development, 46, 773-778.

Fry, G. A. (1952) *The relationship between geometrical perspective and stereo cues.* American Journal of Optometry, 29, 353-368.

Fujimoto, K. (1981) *Children's copies of similar three-dimensional objects.* Psychologica, 24, 55-64.

Furth, H. G. (1969) *Piaget and Knowledge.* Prentice Hall.

Gardner, H. (1980) *Artful Scribbles - The Significance of Children's Drawings.* London: Jill Norman Ltd.

Ghent, L. (1956) *Perception of overlapping and embedded figures by children of different ages.* American Journal of Psychology, 69, 575-587.

Gibson, E. J., Gibson, J. J., Pick, A. D. and Osser, H. (1962) *A developmental study of the discrimination of letter-like forms.* Journal of Comparative and Physiological Psychology, 55, 897-906.

Gibson, J. J. (1950) *The Perception of the Visual World.* Boston: Houghton Mifflin.

Gibson, J. J. (1978) *The ecological approach to the visual perception of pictures.* Boston: Houghton Mifflin.

Gogel, W. C. (1974) *Cognitive factors in spatial responses.* Psychologica, 17, 213-225.

Golomb, C. (1973) *Children's representation of the human figure: the effects of models, media and instruction.* Genetic Psychology Monographs, 87, 197-251.

Golomb, C. (1974) *Young children's sculpture and drawing.* Cambridge, Mass.: Harvard University Press

Golomb, C. (1981) *Representation and reality: the origins and determinants* *of young children's drawings.* Review of Research in Visual Arts Education, 14, 36-48.

Golomb, C. (1982) *Young children's planning strategies and early learning principles of spatial organisation in drawing.* Paper presented at the N.A.T.O. Conference on Intelligence and Learning, University of York.

Gombrich, E. H. (1960) *Art and Illusion.* Princetown N. J.: Princetown University Press.

Goodnow, J. J. (1977) *Children's Drawings.* London: Open Books.

Goodnow, J. J. (1978) *Visible thinking: cognitive aspects of change in children's drawings.* Child Development, 49, 637-641.

Goodnow, J. and Friedman, S. (1972) *Orientation in children's human figure drawings.* Developmental Psychology, 7, 10-16.

Goodnow, J. J. and Levine, R. (1973) *The grammer of action: sequence and syntax in children's copying.* Cognitive Psychology, 4, 82-98.

Hagen, M. A. (1976a) *Development of ability to perceive and produce the pictorial depth cue of overlapping.* Perceptual and Motor Skills, 42, 1007-1014.

Hagen, M. A. (1976b) *The influence of picture surface and station point on the ability to compensate for oblique view in pictorial perception.* Developmental Psychology, 12, 57-63.

Hagen, M. A (1985) *There is no development in art.* in Freeman, N. H. and Cox, M. V. (Eds), Visual Order: The nature and development of pictorial representation. Cambridge: Cambridge University Press.

Hagen, M. A. and Elliott, H. B. (1976) *An investigation of the relationship between viewing condition and preference for true and modified linear perspective with adults.* Journal of Experimental Psychology, Human Perception and Performance, 2, 479-490.

Hagen, M. A. and Jones, R. K. (1978) *Differential patterns of preference for modified linear perspective in adults and children.* Journal of Experimental Child Psychology, 26, 205-215.

Hagen, M. A. and Jones, R. K. (1980) *A perspective on cross-cultural picture perception.* in Hagen, M. A. (Ed), The perception of Pictures, Volume 2. New York: Academic Press.

Haith, M. M. (1971) *Developmental change in visual information processing and short term memory.* Human Development, 14, 249-261.

Hargreaves, P. J., Jones, P. M. and Martin, D. (1981) *The air-gap phenonomen in children's landscape drawings.* Journal of Experimental Child Psychology, 32, 11-20.

Harris, D. B. (1963) *Children's drawings as measures of intellectual* *maturity*. New York: Harcourt, Brace and World.

Harris, L. J. and Strommen, B. A. (1972) *The role of front-back features in children's 'front', 'back' and 'beside' placement of objects*. Merrill-Palmer Quarterly, 18, 259-271.

Hart, L. M. and Goldin-Meadow, S. (1984) *The child as a nonegocentric art critic*. Child Development, 55, 2122-2129.

Hebb, D. O. (1968) *Concerning Imagery*. Psychology Review, 75, 466-477.

Hermelin, B. and O'Connor, N. (1986) *Spatial representations in mathematically and in artistically gifted children*. British Journal of Educational Psychology, 56, 150-157.

Hochberg, J. and Brooks, V. (1962) *Pictorial recognition as an unlearned ability: A study of one child's performance*. American Journal of Psychology, 75, 624-628.

Hochberg, J. and Gellman, L. (1977) *The effect of landmark features on 'mental rotation' times*. Memory and Cognition, 5, 23-26.

Horowitz, M. J. (1970) *Image Formation and Cognition*. London: Butterworth.

Huffman, D. A. (1971) *Impossible objects as nonsense sentances*. Machine Intelligence, 6, 295-323.

Hughes, M. (1978) *Selecting pictures of another persons view*. British Journal of Educational Psychology, 48, 210-219.

Hughes, M. and Donaldson, M. (1979) *The use of hiding games for studying the coordination of viewpoints*. Educational Review, 31, 133-140.

Huttenlocher, J. (1968) *Constructing spatial images: a strategy in reasoning*. Psychology Review, 75, 550-560.

Ibbotson, A. and Bryant, P. E. (1976) *The perpendicular error and the vertical effect*. Perception, 5, 319-326.

Ingram, N. (1985) *Three into two won't go: Symbolic and spatial coding processes in young children's drawings*. in Freeman, N. H. and Cox, M. V. (Eds), Visual Order: The nature and development of pictorial representation. Cambridge: Cambridge University Press.

Inhelder, B. (1965) *Operational thought and symbolic imagery*. in Mussen, P. H. (Ed), European Research in Cognitive Development, Monographs of the Society for Research in Child Development, 100, 30, 2.

Inhelder, B. and Chipman, H. H. (1976) *Piaget and his School*. New York: Springer Verlag.

Itskowitz, R., Glaubman, H. and Hoffman, M. (1988) *The impact of age and artistic inclination on the use of articulation and line quality in similarity and preference judgements*. Journal of Experimental Child Psychology, 46, 21-34.

Ives, S. W. (1980a) *The use of orientations in children's drawings of familiar objects: principles versus percepts.* British Journal of Educational Psychology, 50, 295-296.

Ives, S. W. (1980b) *Preschool children's ability to coordinate spatial perspectives through language and pictures.* Child Development, 51, 1303-1307.

Ives, S. W. and Rovet, J. (1979) *The role of graphic orientations in childrens drawings of familiar and novel objects at rest and in motion.* Merrill-Palmer Quarterly, 25, 281-292.

Ives, S. W. and Houseworth, M. (1980) *The role of standard orientations in children's drawing of interpersonal relationships: Aspects of graphic feature making.* Child development, 51, 591-593.

Ives, S. W. and Rovet, J. (1981) *Elementary school children's use of construction rules in drawings of familiar and novel objects: A cross cultural replication.* Journal of Genetic Psychology,

Jahoda, G. (1981a) *Drawing styles of schooled and unschooled adults: a study in Ghana.* Quarterly Journal of Experimental Psychology, 33a, 133-143.

Jahoda, G. (1981b) *The influence of schooling on adult recall of familiar stimuli: a study in Ghana.* International Journal of Psychology, 16, 59-71.

Jahoda, G. and McGurk, H. (1974a) *Pictorial depth perception: A developmental study.* British Journal of Psychology, 65, 141-149.

Jahoda, G. and McGurk, H. (1974b) *Pictorial depth perception in Scottish and Ghanian children.* International Journal of Psychology, 9, 255-267.

Jahoda, G. and McGurk, H. (1974c) *Development of pictorial depth perception: cross cultural replication.* Child Development, 45, 1042-1047.

Jahoda, G. and McGurk, H. (1974d) *The development of pictorial depth perception: the role of figural elevation.* British Journal of Psychology, 65, 367-376.

Jahoda, G., Deregowski, J. B., Ampene, E. and Williams, N. (1977) *Pictorial recognition as an unlearned ability.* in Butterworth, G. (Ed), The Child's Representation of the World. Plenum Press.

Johnson-Laird, P. (1972) *The three-term series problem.* Cognition, 1, 57-82.

Jools, P. (1982) *Children's representations in drawings and speech: content and structure.* Paper presented at Conference at Keele University.

Kalyan-Masih, V. (1976) *Graphic representation: from intellectual realism to visual realism in Draw-a-House-Tree task.* Child Development, 47, 1026-1031.

Kellogg, R. (1970) *Analysing Children's Art*. Palo Alto: National Press.

Kellogg, R. (1979) *Children's Drawings, Children's Minds*. U. S. A.: Avon Books.

Kemler, D. G. (1983) *Wholistic and analytic models in perceptual and cognitive development*. in Tighe, and Shepp, (Eds), Perception, Cognition and Development: Interractional Analyses. Hilsdale N. J.: Erlbaum.

Kennedy, J. M. (1974) *A Psychology of Picture Perception: Images and Information*. San Francisco: Jossey-Bass.

Kennedy, J. M. (1979) *Subjective contours, contrast and assimilation*. in Nodine, C. F. and Fisher, D. F. (Eds), Perception and Pictorial Representation. New York: Praeger Publishers.

Kennedy, J. M. (1980) *Blind people recognising and making haptic pictures*. in Hagen, M. (Ed), The Perception of Pictures, Volume 2. New York: Academic Press.

Kennedy, J. M. (1983) *What can we learn about pictures from the blind?* American Scientist, 71, 19-26.

Kennedy, J. M. and Silver, J. (1974) *The surrogate functions of lines in visual perception: Evidence from antipodal rock and cave artwork sources*. Perception, 3, 313-322.

Kennedy, J. M. and Ross, A. S. (1975) *Outline picture perception by the Songe of Papua*. Perception, 4, 391-406.

Kestenbaum, R., Termine, N. and Spelke, E. S. (1987) *Perception of objects and object boundaries by 3-month-old infants*. British Journal of Developmental Psychology, 5, 367-383.

Kosslyn, S. M. (1975) *Information representation in visual images*. Cognitive Psychology, 7, 341-370.

Kosslyn, S. M. (1976) *Can imagery be distinguished from other forms of internal representation? Evidence from studies of information retrieval time*. Memory and Cognition, 4, 291-297.

Kosslyn, S. M. (1978a) *Imagery and cognitive development: A teleological approach*. in Siegler, R. S. (Ed), Children's Thinking: What Develops?. Hillsdale N. J.: Lawrence Erlbaum.

Kosslyn, S. M. (1978b) *Imagery and internal representation*. in Rosch, E. and LLoyd, B. B. (Eds), Cognition and Catagorisation. Hillsdale N.J.: Lawrence Erlbaum.

Kosslyn, S. M., Heldmeyer, K. H. and Locklear, E. P. (1977) *Children's drawings as data about internal representations*. Journal of Experimental Child Psychology, 23, 191-211.

Lark-Horowitz, B., Lewis, H. and Luca, M. (1967) *Understanding Children's Art* *for Better Teaching*. Columbus Ohio: Merril.

Laszlo, J. I. and Broderick, P.A. (1985) *The perceptual-motor skill of drawing*. in Freeman, N. H. and Cox, M. V. (Eds.), Visual Order: The nature and development of pictorial representation. Cambridge: Cambridge University Press.

Lewis, H. P. (1963) *Spatial representation in drawing as a correlate of development and a basis for picture preference*. Journal of Genetic Psychology, 102, 95-107.

Liben, L. (1978) *Perspective-taking skills in young children: Seeing the world through rose-coloured glasses*. Developmental Psychology, 14, 87-92.

Liben, L. and Belknap, B. (1981) *Intellectual realism: Implications for investigations of perceptual perspective-taking*. Child Development, 52, 921-924.

Light, P. H. (1982) *The use of communication tasks to investigate depiction of spatial relationships in young children's drawings*. Paper presented at the N.A.T.O. conference at Keele University.

Light, P. H. (1984) *Drawings as messages*. Paper presented at the British Psychological Society Conference, Developmental Section: Lancaster University.

Light, P. H. (1985) *The development of view-specific representation considered from a socio-cognitive standpoint*. in Freeman, N. H. and Cox, M. V. (Eds.), Visual Order: The nature and development of pictorial representation. Cambridge: Cambridge University Press.

Light, P. H. and MacIntosh, C. (1980) *Depth relationships in young children's drawings*. Journal of Experimental Child Psychology, 30, 79-87.

Light, P. H. and Humphreys, J. (1981) *Internal spatial relationships in young children's drawings*. Journal of Experimental Child Psychology, 31, 521-530.

Light, P. H. and Simmons, B. (1983) *The effects of a communication task upon the representation of depth relationships in young children's drawings*. Journal of Experimental Child Psychology, 35, 81-92.

Light, P. H. and Nix, C. (1983) *'Own view' versus 'good view' in a perspective-taking task*. Child Development, 54, 480-483.

Light, P. H. and Foot, T. (1986) *Partial occlusion in young children's drawings*. Journal of Experimental Child Psychology, 41, 38-48.

Light, P. H. and McEwen, F. (1987) *Drawings as messages: The effect of a communication game upon production of view-specific drawings*. British Journal of Developmental Psychology, 5, 53-60.

Lindstrom, M. (1967) *Children's Art*. Berkeley: University of California Press.

Lowenfeld, V. and Brittain, W. L. (1966) *Creative and Mental Growth (4th edition)*. New York: Macmillan.

Luquet, G. H. (1927) *Le dessin enfantin*. Paris: Alcan.

Lynch, K. (1960) *The Image of the City*. Cambridge: M.I.T. Press.

Mackay, C. K., Brazendale, A. H. and Wilson, L. F. (1972) *Concepts of horizontal and vertical: A methodological note*. Developmental Psychology, 7, 232-237.

Mackworth, A. K. (1976) *Model driven interpretation in intelligent vision systems*. Perception, 5, 349-370.

Marmor, G. S. (1975) *Development of kinetic images: when does the child first represent movement in mental images*. paper presented at the Meeting of the Society for Research in Child Development. Denver University.

Marr, D. (1982) *Vision*. San Francisco: Freeman.

Marr, D. and Nishihara, H. K. (1978) *Representation and recognition of the spatial organisation of three-dimensional shapes*. Proceedings of the Royal Society, 200, 269-294.

Mascell, J. V. (1966) *The 5 C's of Cinematography*. California: Cini-graphic Publications.

Mayhew, J. and Frisby, J. (1984) *Computor Vision*. in O'Shea, T. and Eisenstadt, M. (Eds), Artificial Intelligence: Tools, Techniques, and Applications. New York: Harper and Row.

McClelland, J. L. and Miller, J. (1979) *Structural factors in figure perception*. Perception and Psychophysics, 26, 221-229.

McGurk, H. (1972) *The salience of orientation in young children's perception of form*. Child Development, 43, 1047-1052.

McGurk, H. and Jahoda, G. (1974) *The development of pictorial depth perception: the role of figural elevation*. British Journal of Psychology, 65, 367-376.

Medin, D. L. (1983) *Structural principles in catagorisation*. in Tighe, T. J. and Shepp, B. E. (Eds), Perception, Cognition and Development: Interractional Analyses. Hillsdale N.J.: Erlbaum.

Mendleson, M. J. and Lee, S. P. (1981) *The effects of symmetry and contour on recognition memory in children*. Journal of Experimental Child Psychology, 32, 373-388.

Metz, P. (1929) *Die eidetische Anlage der Jugendlichen in iher Beziehung zur kunstlerischen Gestaltung*. Langensalza: H. Beyer and Sons.

Millar, S. (1975) *Visual experience or translation rules? Drawing the human figure by blind and sighted children.* Perception, 4, 363-371.

Millar, S. (1977) *Spatial representation by blind and sighted children.* in Butterworth, G. (Ed), The Child's Representation of the World. New York: Plenum Press.

Miller, P. (1983) *Theories of Developmental Psychology.* San Francisco: Freeman.

Minnigerode, F. A. and Carey, R. N. (1974) *Development of mechanisms underlying spatial perspectives.* Child Development, 45, 496-498.

Minsky, M. L. and Papert, J. S. (1972) *Progress Report, A. I. memorandum 252.* Massachusetts Institute of Technology, Cambridge, Mass.

Mitchelmore, M. C. (1978) *Developmental stages in children's representation of regular solid figures.* Journal of Genetic Psychology, 133, 229-239.

Mitchelmore, M. C. (1980a) *Prediction of developmental stages in the representation of regular space figures.* Journal for Research in Mathematical Education, 11, 83-93.

Mitchelmore, M. C. (1980b) *Three-dimensional geometric drawing in three cultures.* Educational Studies in Mathematics, 11, 205-216.

Mitchelmore, M. (1985) *Geometrical foundations of children's drawing.* in Freeman, N. and Cox, M. (Eds.), Visual Order: The nature and development of pictorial representation. Cambridge: Cambridge University Press

Moar, I. (1977) *Spatial organisation in the recall of pictorial stimuli.* Quarterly Journal of Experimental Psychology, 29, 699-708.

Moore, V. (1986a) *The relationship between children's drawings and preferences for alternative depictions of a familiar object.* Journal of Experimental Child Psychology, 42, 187-198.

Moore, V. (1986b) *The use of a colouring task to elucidate children's drawings of a solid cube.* British Journal of Developmental Psychology, 4, 335-340.

Moore, V. (1987) *The influence of experience on children's drawiings of a familiar and unfamiliar object.* British Journal of Developmental Psychology, 5, 221-229.

Naeli, H. and Harris, P. (1976) *Orientation of the diamond and the square.* Perception, 5, 73-78.

Neisser, U. (1967) *Cognitive Psychology.* New York: Appleton-Century-Crofts.

Neisser, U. (1972) *Changing conceptions of imagery.* in Sheenan, P. W. (Ed), The Function and Nature of Imagery. New York: Academic Press.

Neisser, U. (1982) *Towards a skillful psychology.* paper presented at the N.A.T.O. Conference, Keele University.

Newson, E. (1979) *Making sense of autism: an overview.* University of Nottingham: Child Development Research Unit.

Nicholson, J. R. and Seddon, G. M. (1977) *The influence of secondary depth cues on the understanding by Nigerian schoolboys of spatial relations in pictures.* British Journal of Psychology, 68, 327-333.

Ninio, A., Lieblich, A. and Kugelmass, S. (1975) *Developmental trends in directionality of drawing in Jewish and Arab Israeli children.* Journal of Cross Cultural Psychology, 6, 504-511.

Ninio, A. and Lieblich, A. (1976) *The grammer of action: 'phrase structure' in children's copying.* Child Development, 47, 846-849.

O'Connor, N. O. and Hermelin, B. (1983) *The role of general and specific talents in information processing.* British Journal of Developmental Psychology, 1, 389-403.

O'Connor, N. O. and Hermelin, B. (1987) *Visual memory and motor programmes: Their use by idiot-savant artists and controls.* British Journal of Psychology, 78, 307-323.

Oh, C. Y. (1968) *A study of the development of children's ability to perceive depth in static two-dimensional pictures.* Ph.D. Thesis, University of Indiana.

Olson, D. R. (1970) *Cognitive Development: The Child's Acquisition of Diagonality.* New York: Academic Press.

Olson, R. K. (1975) *Children's sensitivity to pictorial depth information.* Perception and Physiological Psychology, 17, 59-64.

Paraskevopoulos, I (1968) *Symmetry, recall, and preference in relation to chronological age.* Journal of Experimental Child Psychology, 6, 254-264.

Parisier, D. A. (1976) *Children's drawings of wrecked cars: A study in the development of form.* Ph.D. thesis, Harvard Graduate School of Education.

Pentland, A. P. (1986) *Perceptual organisation and the representation of natural form.* Artificial Intelligence, 28, 293-331.

Phillips, W. A. and Christie, D. F. M. (1977) *Interference with visualisation.* Quarterly Journal of Experimental Psychology, 29, 637-650.

Phillips, W. A., Hobbs, S. B. and Pratt, F. R. (1978) *Intellectual realism in children's drawings of cubes* Cognition. 6, 15-23

Phillips, W. A., Inall, M. and Lauder, E. (1985) *On the discovery, storage and use of graphic descriptions.* in Freeman, N. H. and Cox, M. V. (Eds), Visual Order: The Nature and Development of Pictorial Representation. Cambridge: Cambridge University Press.

Piaget, J. (1977) *Intellectual evolution from adolescence to adulthood* in Johnson-Laird, P. N. and Wason, P. C. (Eds.), Thinking: Readings in

Cognitive Science. Cambridge University Press

Piaget, J. and Inhelder, B. (1956) *The Child's Conception of Space*. London: Routledge and Kegan Paul.

Piaget, J. and Inhelder, B. (1969) *The Psychology of the Child*. London: Routledge and Kegen Paul.

Pirenne, M. H. (1970) *Optics, Painting, and Photography*. Cambridge: Cambridge University Press.

Plumb, C. C. (1969) *The effect of structural depth cues on delayed recognition responses and evaluative ratings of visual displays*. Ph.D. thesis, Indiana University.

Pomerantz, J. R. (1977) *Pattern goodness and speed of encoding*. Memory and Cognition, 5, 235-241.

Pratt, F. R. (1982) *Intellectual realism in adult's and children's copies of cubes and straight lines*. paper presented at the N.A.T.O. Conference, Keele University.

Pratt, F. R. (1985) *A perspective on traditional artistic practices*. in Freeman, N. H. and Cox, M. V. (Eds), Visual Order: The nature and development of pictorial representation. Cambridge: Cambridge University Press.

Pufall, P. B. and Shaw, R. E. (1973) *An analysis of the development of children's spatial reference systems*. Cognitive Psychology, 5, 151-175.

Pylyshyn, Z. W. (1973) *What the mind's eye tells the mind's brain*. Psychological Bulletin, 80, 1-24.

Pylyshyn, Z. W. (1980) *Computation and Cognition: issues in the foundations of cognitive science*. The Behavioral and Brain sciences, 3, 111-169.

Quinn, P. C. and Bomba, P.C. (1986) *Evidence for a genertal category of oblique orientations in four-month-old infants*. Journal of Experimental Child Psychology, 42, 345-354.

Radkey, A. L. and Enns, J. T. (1987) *Da Vinci's window facilitates drawing of total and partial occlusion in young children*. Journal of Experimental Child Psychology, 33, 222-235.

Rand, C. W. (1973) *Copying in drawing: the importance of adequate visual analysis versus the ability to utilise drawing rules*. Child Development, 44, 47-53.

Ratoosh, P. (1949) *An inter-position as a cue for the perception of distance*. in Proceedings of the National Academy of Science, 35, 257-259.

Reese, H. W. (1973) *Imagery in children's learning, a symposium*. Psychological Bulletin, 73, 383-421.

Reese, H. W. (1977) *Towards a cognitive theory of mnemonic imagery*. Journal of Mental Imagery, 2, 229-244.

Reeves (1983) *Children's perception and production of pictorial devices: A review of the evidence and its implications*. paper presented at N.A.T.O Conference on Intelligence and Learning: York University.

Reith, E. (1988) *The development of use of contour lines in children's drawings of figurative and non-figurative three-dimensional models*. Archives de Psychologie, 56, 83-103.

Reynolds, E. (1981) *The effect of different verbal instructions on young children's drawings of a familiar object*. Honours Dissertation, University of Oxford.

Rock, I., Halper, F. and Clayton, T. (1972) *Perception and recognition of complex figures*. Cognitive Psychology, 3, 655-673.

Rock, I., Schallo, J. and Schwartz, F. (1978) *Pictorial depth and related constancy effects as a function of recognition*. Perception, 7, 3-20.

Roodin, P. A., Vaught, G. M., Simpson, W. E. and Schmitt, N. (1971a) *Bunnies and baskets: a temporal analysis of children's drawings before and after Easter*. Personality, 2, 271-278.

Roodin, P. A., Vaught, G. M. and Simpson, W. E. (1971b) *Christmas tree drawings before and after Christmas: a re-examination*. Perceptual and Motor Skills, 33, 365-366.

Roodin, P. A., Vaught, G. M. and Simpson, W. E. (1973) *Correlational analysis of changes in children's easter drawings as a function of a naturally motivated expectancy*. Social Behaviour and Personality, 1, 43-49.

Rosch, E. (1975) *Cognitive representations of semantic categories*. Journal of Experimental Psychology, 104, 192-233.

Rosch, E. (1976) *Cognitive reference points*. Cognitive Psychology, 7, 532-547.

Rosch, E., Mervis, C., Gray, W., Johnson, D. and Boyes-Graem, P. (1976) *Basic objects in natural categories*. Cognitive Psychology, 8, 382-439.

Rosinski, R. R. (1976) *Picture perception and monocular vision: a reply to Hagen*. Psychological Bulletin, 83, 1172-1175.

Roth, I. and Frisby, J.P. (1986) *Perception and Representation: A Cognitive Approach*. Milton Keynes: Open University Press.

Rutter, M. (1978) *Diagnosis and definitions*. in Rutter, M. and Schopler, E. (Eds), Autism: A reappraisal of concepts and treatment. New York: Plenum.

Saenger, E. A. (1981) *Drawing systems: a developmental study of representation*. Ph.D. thesis, Department of Social Psychology, Harvard

University. (Cited in Willats, 1977, 1981, 1985, but copy of the original document appears to be unobtainable).

Schaller, M. J. and Harris, L. J. (1974) *Children judge 'perspective' transformations of letter-like forms as different from prototypes.* Journal of Experimental Child Psychology, 18, 226-241.

Selfe, L. (1977) *Nadia: a case of extraordinary drawing ability in an autistic child.* London : Academic Press

Selfe, L. (1983a) *The representation of diminishing size with distance as a means of depicting depth in children's drawings.* Paper presented at N.A.T.O. Conference on Intelligence and Learning: York University.

Selfe, L. (1983b) *Normal and anomalous representational drawing ability in children* London: Academic Press

Selfe, L. (1985) *Anamolous drawing development: some clinical studies.* in Freeman, N. and Cox, M. (Eds.), Visual Order: The nature and development of pictorial representation. Cambridge: Cambridge University Press

Shepard, R. N. (1975) *Studies of the form, formation, and transformation of internal representations.* in Solso, R. (Ed), Information Processing and Cognition. The Loyola Symposium. Potomac M.D.: Lawrence Erlbaum.

Shepard, R. N. and Chipman, H. H. (1970) *Second order isomorphism of internal representations: shapes of states.* Cognitive Psychology, 1, 1-17.

Shepard, R. N. and Metzler, J. (1971) *Mental rotation of three-dimensional objects.* Science, 171, 701-703.

Shepp, B. E. (1983) *The analyzability of multidimensional objects: some constraints on perceived structure, the development of perceived structure and attention.* in Tighe, T. J. and Shepp, B. E. (Eds), Perception, Cognition and Development: Interractional Analyses. Hillsdale N.J.: Erlbaum.

Siegal, S. (1956) *Nonparametric statistics for the behavioral sciences.* London: McGraw Hill.

Siegler, R. S. (1978) *Children's Thinking: What Develops?* Hillsdale N.J.: Erlbaum.

Silk, A. M. and Thomas, G. V. (1986) *Development and differentiation in children's figure drawings.* British Journal of Psychology, 77, 399-410.

Silk, A. M. and Thomas, G. V. (1988) *The development of size scaling in children's figure drawings.* British Journal of Developmental Psychology, 6, 285-299.

Simon, H. A. (1972) *What is visual imagery?.* in Gregg, L. W. (Ed), Cognition in Learning and Memory. Wiley.

Simon, H. A. and Barenfeld, M. (1969) *Information processing analysis of perceptual processes in problem solving.* Psychological Review, 76, 473-483.

Sinha, D. and Misra, P. (1975) *Use of pictorial depth cues in children's paintings: a developmental study.* Indian Journal of Psychology, 50, 222-231.

Slack, J. (1984) *Cognitive science research.* In O'Shea, T. and Eisenstadt, M. (Eds), Artificial Intelligence: Tools, Techniques and Applications. New York: Harper Row.

Smothergill, D. W, Hughes, F.P., Timmons, S. A. and Hutko, P. (1975) *Spatial visualising in children.* Developmental Psychology, 11, 4-13.

Sovik, N. (1980) *Developmental trends of visual feedback control and learning in children's copying and tracking skills.* Journal of Experimental Education, 49, 106-119.

Sovik, N. (1982) *Cybernetic theory and research with regard to learning performance of psychomotor skills, copying and handwriting in particular.* Paper presented at N.A.T.O. Conference, Keele University.

Spielman, K. S. (1976) *Development of the perception and production of line forms.* Child Development, 47, 787-793.

Spiker, C. C. and Cantor, J. H. (1983) *Componants in the hypothesis testing strategies of young children.* in Tighe, T. J. and Shepp, B. E. (Eds), Perception, Cognition and Development: Interractional Analyses. Hillsdale N.J.: Erlbaum.

Spitz, H. H. and Borland, M. D. (1971) *Redundancy in line drawing of familiar objects: effects of age and intelligence.* Cognitive Psychology, 2, 196-250.

Stein, N. L. and Mandler, J. M. (1975) *Development of detection and recognition of orientation of geometric and real figures.* Child Development, 46, 379-388.

Stotijn-Egge, S. (1952) *Investigation of the drawing ability of low grade subnormals.* Leiden: Luctor et Emergo, 158, 172.

Strayer, J. and Ames, E.W. (1972) *Stimulus orientation and the apparant developmental lag between perception and performance.* Child Development, 43, 1345-1354.

Sudipatik, L. (1972) *The effects of information-level and depth cues as portrayed in static two-dimensional pictures on the perception of depth by children aged five and six.* Ph.D. Thesis: Indiana University.

Taylor, M. and Bacharach, V. R. (1981) *The development of drawing rules: Metaknowledge about drawing influences performance on non-drawing* *tasks*. Child Development, 52, 373-375.

Taylor, M. and Bacharach, V. R. (1982) *Constraints on the visual accuracy of drawings produced by young children*. Journal of Experimental Child Psychology, 34, 311-329.

Thomas, G. V. and Tsalimi, A. (1988) *Effects of order of drawing head and trunk on their relative sizes in children's human figure drawings*. British Journal of Developmental Psychology, 6, 191-204.

Van Somers, P. (1982) *The conservatism of children's drawing strategies. At what level does stability persist?* Paper presented at N.A.T.O. Conference, Keele University.

Vurpillot, E. (1969) *Influence of the nature of a difference on its detection by children of pre-school age*. Enfance, 3-4, 149-164.

Vurpillot, E. and Ball, W. A. (1979) *The concept of identity and children's selective attention*. in Hale, G. and Lewis, M. (Eds), Attention and Cognitive Development. New York: Plenum.

Walker, J. T. and Walker, M. J. (1988) *The apparent size of three-dimensional objects and their silhouettes: a solid-superiority effect*. Perception, 17, 23-30.

Waltz, D. (1975) *Understanding line drawings of scenes with shadows*. in Winston, P. H. (Ed), The Psychology of Computor Vision. New York: McGraw-Hill.

Wilcox, B. L. and Teghtsoonian, M. (1971) *The control of relative size by pictorial depth cues in children and adults*. Journal of Experimental Child Psychology, 11, 413-429.

Willats, J. (1977a) *How children learn to draw realistic pictures. Quarterly Journal of Experimental Psychology, 29, 000-016.*

Willats, J. (1977b) How children learn to represent three-dimensional space in drawings. in Butterworth, G. (Ed), The Child's Representation of the world. New York: Plenum Press.

Willats, J. (1981a) *Formal structures in drawing and painting. Ph.D. Thesis, Faculty of Arts, North-East London Polytechnic.*

Willats, J. (1981b) What do the marks in the picture stand for? The child's acquisition of systems of transformation and denotation. Review of Research in Art Education. 13, 18-33.

Willats, J. (1983) *Drawing systems revisited: the complementary roles of projection systems and denotation systems in the analysis of childrens drawings*. Paper presented at N.A.T.O. Conference on Intelligence and Learning: York University.

Willats, J. (1984) *Getting the drawing to look right as well as be right:*

the interraction between production and perception as a mechanism of development. in Crozier, W. R. and Chapman, A. J. (Eds), Cognitive Processes in the Perception of Art. Amsterdam: North Holland.

Willats, J. (1985) *Drawing systems revisited: the role of denotation systems in children's figure drawings.* in Freeman, N. H. and Cox, M. V. (Eds), Visual Order: The nature and development of pictorial representation. Cambridge: Cambridge University Press.

Willats, J. (1987) *Marr and pictures: An information processing account of children's drawings.* Archives de Psychologie, 55, 105-125.

Wilson, M. and Wilson, B. (1982) *The case of the disappearing two-eyed profile: or how little children influence the drawings of little children.* Review of Research in Visual Arts Education, 15, 19-32.

Wollheim, R. (1969) *Representation: the philosophical contribution to psychology.* in Butterworth, G. (Ed), The Child's Representation of the world. New York: Plenum Press.

Wood, D., Shotter, J. and Godden, D. (1974) *An investigation into the relationship between problem solving strategies, representation and memory.* Quarterly Journal of Experimental Psychology, 26, 252-257.

Appendices to:

DEVELOPMENT IN THE DEPICTION OF DEPTH.

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APPENDIX TO CHAPTER 1.

Overview of Theories about Development in Drawing.

This appendix presents a more detailed discussion of the theoretical basis for group of conceptual/perceptual realism theories presented in Chapter 1.

A) WHAT WE 'KNOW' OF THE OBJECT: PERCEPTION.

Marr (1982) proposed a three stage process of visual perception. He suggested that firstly a point by point representation of image intensities occurs, from which a primal sketch is computed. This makes explicit only changes in local intensity values, such as edges of objects or surface markings. A grouping process then occurs in which locally adjacent primitives are grouped into small 'edge segments' and assigned an orientation, thus producing an explicit description of local image intensity changes called the raw primal sketch. Finally local information is grouped into large scale contours or regions to form the full primal sketch, on principles of continuity, proximity and similarity. This involves the principle of 'least commitment' in which grouping does not occur in a single pass but instead utilises several stages that are characterised by the progressive relaxation of the requirements for joining elementary descriptions. Such a grouping mechanism can be used to explain subjective contours (Kennedy 1979). At this stage the attributes of the image are described without forming any hypothesis of what things might be, in the associated sense. Whilst some knowledge of the visual world is needed at this stage, the knowledge is of a very general kind. Mayhew and Frisby (1984) state that *"implicit in the way we represent an occluding contour there are the a priori assumptions that where the occluding contour looks continuous it really is, and the convex/concave segments of the contour reflect similar properties of the generating surface, and that the generating surface is a* generalised *cylinder/cone"*. Thus a single line can be seen to have depth (Marr and Nishihara 1978) and may be seen to have many functions. For example the simple closed form of the circle on an otherwise blank background can depict a flat disc, a hole, a wire hoop, or a ball (Kennedy 1974). Other pictorial alternatives are possible, employing transparency (Metelli 1974).

The intrinsic image.

A central part of Marr's theory, and of some computer vision systems, is that of the intrinsic image, which is an intermediate representation that makes explicit various aspects of visible surfaces. This is Marr's 2½ D sketch which "*provides a representation of objective physical reality that precedes the decomposition of the scene into objects and all the concommitant difficulties associated with object recognition*" (Marr 1982). For example, Mackworth (1976) argued that intelligent vision systems need an a priori knowledge of objects when interpreting line drawings.

It is this aspect of his theory that some researchers, such as Gibson, have found to be most contentious. Gibson's views are discussed more fully in section c of this appendix, but it is worth noting here that recent research in artificial intelligence has relaxed the need for an a-priori knowledge of objects. Fisher (1982) suggested that we decompose objects into symbolic elements. For example, the perception of a table would involve the perception of the table top and the table legs, each as separate symbolic elements. He showed that a computer could identify tables in this way, even if the edge data and boundary connections were missing. In 1986 he proposed that an object recognition system first needs a figure ground separation mechanism, and then explicit information in the surface image is used to group surfaces to form a 'blob' level, identity independent, representation of three dimensional solids in the scene. Thus he suggests the use of an intermediate representation, that falls between the 2½D sketch and the model based object hypothesis. Pentland (1986) produced a similar suggestion. He argued that the perceptual systems are, at least partially, organised to extract 'lumps' from the environment, and that we deduce the parameters of the 'lumps' from information about surface tilt. In 1987 Fisher proposed S. M. S.. This is a suggestive modelling system for object recognition, in which integrated multiple alternative representations use symbolic primitives to suggestively characterise the object and its shape. These views are in accordance with Roth and Frisby's (1986) discussion of Marr's theory. They suggest that whilst Marr's theory is essentially one involving 'bottom up' processing, it also involves knowledge. However, this is not knowledge of objects or things, or of the world as such, but is 'procedurally embedded knowledge' in which perception is guided by general rules about the way in which the world is organised.

It is, perhaps, unwise to base a theory about human perception too firmly upon work done in artificial intelligence, although Pylyshyn (1980) suggests that the two can be linked under certain circumstances. He argues that both computation and cognition are governed by rules acting on symbolic representations. Thus, under clearly defined conditions, in particular for areas that cannot be influenced by purely cognitive factors such as goals, beliefs, inferences and tacit knowledge, there are great similarities between the processes involved in computation and cognition. Unfortunately it is difficult to be clear about the extent to which cognitive factors, as defined by Pylyshyn, do influence perception. Marr's work suggests that, under this definition, cognitive factors are not directly involved in perception, and so work in artificial intelligence might be relevant to our understanding of the processes of human perception. Recent work by Kestenbaum *et al* (1987) on infant perception reinforces this. They found that three month old babies perceive object boundaries by detecting the arrangement of surfaces in depth.

Properties of the system.

Marr suggests that the representation system for a three dimensional shape needs to be:- a) Object Centred. A viewer centred system would be more accessible for description but, when used for recognition, would be non-canonical and more costly in storage. b) Volumetric. A volumetric system can explicitly carry information about the spatial disposition of the parts of an object that are only implicit in a surface based representation. c) Modular and Hierarchically Organised. If all the primitives were at the same level the lower order descriptions would capture too fine a detail, whereas hierarchical descriptions are intrinsically stable. Thus *"To recognise a visual object is to extract from the image a (hierarchically organised) description of the orientation of its principal and component axes, their adjunct relationships and relative lengths. Then with the principal axis as the basis of the object centred co-ordinate system, the description is matched to a canonical model that is held in memory" (Marr and Nishihara 1978).* Allik and Laak (1985) suggest that a canonical model is a central requirement of Marr's theory.

Canonical models, as such, will be discussed later, but it is worth highlighting one aspect of the above paragraph. Marr has been accused of proposing an 'image-based approach to perception' (Costall 1985), the implication being that these 'images' are static visual percepts. However, whilst Marr uses the term 'image' he does not suggest that, in his taxonomy, the word 'image' has these attributes. The links between imagery and perception, and the view of imagery as dynamic and modality free, are discussed in section c *(What we 'know' of the object: Mental Representation).* It is worth noting that a perceptual theory based on the gradual extraction and grouping of knowledge of the environment, and the 2½ D representation of this knowledge, is not specific to the visual modality. Key relations can be obtained from a given object through other perceptual systems (Kennedy 1980). This is demonstrated by a study of sixteen week old blind children, who, once they had been provided with ultra-sonic spectacles, developed and acted as if they were sighted (Bower 1978).

Development in perception.

Perception is influenced by general cognitive development. Children are better able to organise their attention as they grow older, and the length of examination is extended (Zaprohetz 1969, Vurpillot and Ball 1979). Information pickup is more economical, necessary redundancy decreases with age (Spitz and Borland 1971, Sudipatik 1972), and selectivity becomes more skilled (Bruner *et al* 1966). It follows that perception becomes more analytical (Kemler 1983, Shepp 1983, Medin 1983, Rock *et al* 1972, Elkind 1970).

B) WHAT WE 'KNOW' OF THE OBJECT: CONCEPTUALISATION.

The views expressed above, that objects are perceived in an object centred, hierarchical manner and then identified according to the person's conceptual knowledge, lead naturally to theories about how we conceptualise natural categories of objects. Thus *"Basic objects are seen to be the most inclusive categories for which a concrete image of the category as a whole can be formed, to be the first categorisations to be made during the perception of the environment, to be the earliest sorted and the earliest named by children, and to be the categories most codable, coded, and most necessary in language"* (Rosch *et al* 1976). *"Natural categories are internally structured into a prototype (Clearest case, best example) of the category with non-prototype members tending towards an* *order from better to poorer examples ... best examples serve as reference points in relation to which other category members are judged"* (Rosch 1976). Categories have the advantage that they yield the most information for the least cognitive load.

Canonical orientation.

Rosch (1975) suggested that *"pictures may be closer to the underlying representation than are words"*. It would be unwise to assume that basic level categories have a strongly pictorial nature, but the discussion in the following section, about mental representation, indicates that part of their nature might be imaginal. The use of canonical orientation is widely documented and supported by cross-cultural research (see for example Ives and Houseworth 1980, Ives and Rovet 1979, 1981, Harris and Strommen 1972, Freeman and Janikoun 1972, Reynolds 1981, Arnheim 1974, and Freidman and Stevenson 1975). As Rosch *et al* (1976) suggest *"the high agreement on canonical orientation is itself of interest: one may speculate that the canonical imagined orientation represents the most informative perspective in which to view the object"*

In the previous section it was suggested that the very strong preference for oblique projection indicates that it holds a special position in perception and that this might be because oblique projection offers a non-specific view point. If so it may be the form of projection that most closely approximates to a canonical representation of depth.

C) WHAT WE 'KNOW' OF THE OBJECT: MENTAL REPRESENTATION.

Both perception and conceptualisation can be seen as aspects of mental representation, therefore in order to avoid confusion, quite a close definition will be applied here. Perception can be seen as the process of input, conceptualisation as the process of storage, and mental representation as the process of preparation for output. Thus mental representation indicates the 'workbench' area of information processing. The term 'mental representation' rather than 'mental image' is used to reduce any unwarranted assumptions about its pictorial nature.

Before looking at mental representation it is worth taking a side step to examine a theory of perception proposed by Gibson. It was only briefly discussed in the earlier section on perception for reasons that will be outlined below, but aspects of his theory that he relates particularly to depiction are addressed more fully here.

Gibson's account of perception and depiction.

Gibson (1978) argues that the information in ambient light consists not of form and colours but of invariants, and so perception of a detached object is not compounded from a series of detached forms but depends on invariant features of that family of forms over time.

"It is not that he (the child) sees an abstract cat, or a conceptual cat, or the common features of a class of cats, as some philosophers would have us believe: what he gets is the information for the persistence of that particular, furry, mobile, layout of surfaces. When the young child sees the cat run away, he does not notice the small image, but sees a far-off cat. Thus when he sees two adjacent pictures of Felix in the comic book, a large Felix at the bottom of its picture and another small Felix higher up in its picture, he is prepared to perceive the latter as further off. When he sees the cat half hidden by the chair, he perceives a partly hidden cat, not a half-cat, and therefore he is prepared to see the same thing in a drawing.

The child never sees a man as a silhouette, or as a cut-out like *a paper doll, but probably sees a sort of head-body-arms-legs invariant. Consequently, any outline drawing with this invariant is recognised as a man, and the outlines tend to be seen as the occluding edges of a man with interchangeable near and far sides. Even when the outlines give way to line segments, as in so-called stick figures, the invariant may still be displayed and the man perceived" (pp. 271-272).*

Gibson argues that neither 'concepts' nor 'images' are applicable. *"The invariants are not abstractions or concepts. They are not knowledge, they are simply invariants ... (traditional theory) says that drawing is either from 'life', from 'memory' or from 'imagination': Drawing is always copying. The copying of the perceptual image is drawing from life. The copying of the stored image is from memory. The copying of an image constructed from other memory images is drawing from imagination. This theory is consistent with the mentalistic doctrine that assumes an optical image on the retina, a physiological image on the receptors, a transmitted image on the nerve, a cerebral image in the brain and finally a mental image in the mind that is subject to all sorts of creative transformations ... I insist that what the draftsman, beginner or expert, actually does is not to replicate, to print, or to copy in any sense of the term, but to mark the surface in such a way as to display invariants and record an awareness ... When (the young child) first draws a man or a truck or a table, I suggest, he depicts the invariants that he has learned to notice. He does not draw in patchwork perspective, for he never had the experience of a patchwork. He may not yet draw in edge perspective because he has not noticed it. Hence he may draw a table with a rectangular top and four legs at the corners because those are the invariant features of the table he has noticed. This is a better explanation than saying that he draws what he knows about the table,* *his concept, instead of what he* sees *of the table, his sensation" (pp. 278, 279).*

Perception and mental representation have traditionally been discussed as separate entities. The beauty of this account is that Gibson minimises the difference between them: his work suggests that he believes that mental representation is perception, although he would not agree with this terminology. For example, he is saying that linear perspective is inappropriate as we do not perceive an object in this way and it should not be expected that we would draw it in this way (Costall 1985). Similarly, Bremner and Moore (1984) suggest that we draw what we see over time, rather than at a particular time.

Gibson's theory and mental representation.

Gibson's account is often held to contradict the theories of perception presented above. It is therefore worth considering the extent to which this is indeed the case in terms of practical outcome and testable hypotheses. Whilst Gibson argues against the idea of concepts, the way in which he discusses invariants suggests that he sees them as structures similar to Marr's 2½ D sketch, prior to labelling (albeit structures that exist in the environment rather than internal structures). Gibson's invariants are ecological, not mental. However, ultimately, we only believe that they might be 'out there' because our brain tells us so. Whilst his discussion of their properties and hence their implications for drawing is unclear it would appear from the description above that the use of invariants produces the same results for depiction as would the 2½ D sketch. In particular he uses the idea of invariants to explain size and shape constancies and the importance of occlusion. It is therefore difficult to isolate instances in which the two theories would predict different behaviours.

Further, Gibson's cat is a very conceptual one. He does not agree with the idea of 'image', yet he does accept visualisation of the object (pp. 284). To be able to visualise an object one must have some form of constructible internal representation of that object, which does not appear to be too dissimilar from the arguments discussed above. Similarly he defines drawing as displaying invariants and recording an awareness. Yet presumably, when drawing, some of the ecological invariants become more salient to the task than others. For example, a child cannot draw his mother's voice although this might be one of the invariants that he is aware of. In order to be able to draw his mother he must be able to ignore non-visual invariants hence performing operations upon his awareness of 'mother'. Gibson does suggest that the child displays those invariants he has noticed, thus he could be saying that the child has modality specific invariants, and so only displays visual invariants when drawing. However, modality specific invariants would lead to a very cumbersome mechanism of perception. Finally, Gibson implies that the child learns which invariants are appropriate to notice and so display. Thus, for Gibson, development in depiction appears to occur through a process of selection. This account, involving constructible internal representations, differential saliency of parts of these representations, and development in terms of selection of the appropriateness of parts of these representations in order to achieve the goal of depiction (as defined by the child) does not differ greatly from the general assumptions of the information processing approach.

Development in mental representation.

The developing ability to form a mental representation appropriate to the task demands can be seen to be dependent upon several factors. Children are less able to manipulate mental representations than are adults, although their image space and its properties is similar to those of an adult (Marmor 1975, Smothergill *et al* 1975). Development in the child's ability is not related to the number of knowledge chunks used, but to the appropriateness of these knowledge chunks. With age knowledge chunks become more accessible and more specific. Compared to the adult, the young child uses a greater proportion of literal knowledge structures which are, by their nature, unique and less manipulable than propositional ones. Hence the child is less able to manipulate his or her mental representations (Kosslyn 1978a).

The construction of a mental representation can be seen as a problem solving task, and children have been shown to become more able to adopt a systematic mode of problem solving as they grow older (Spiker and Cantor 1983). Mental representations are constructed, in part, on a basis of encoded perceptual information. Because experience alters the saliency of various cues, and children lack experience, cues that are actually salient to the task in hand may not be seen as such and may not have been encoded. Thus fixation onto a single, irrelevant, dimension might mask problem solving ability (Kosslyn 1978b, Moar 1977).

The ability to encode knowledge and the ability to form mental representations depends in part upon the child's knowledge structures. A cyclical method of development can be postulated in which improved encoding contributes to an improved ability to learn, which in turn contributes to an improved level of existing knowledge. Hence the use of appropriate mental representations will increase with age and ability (Siegler 1978, Brainerd and Heuvel 1974).

As Neisser (1982) suggested, drawing is a skilled behaviour which involves the ability to construct appropriate mental representations and utilise appropriate knowledge structures. Before the child can draw he or she already has a well formed body of conceptual knowledge, but this does not contain much information about how to depict objects. Thus *"Drawings of objects are based on concepts; concepts are based on experience with objects. Experience increases the aspects of objects to be reacted to, understood and incorporated in drawings" (Harris 1963).*

D) GENERAL CONCLUSIONS.

The arguments presented here suggest that, regardless of how 'knowledge' of the object is stored or operated on, it appears to have an object centred nature. The overall picture suggests that the form of projection that best reflects this is oblique projection. It also appears that the depth cue of occlusion is directly linked to the object centred nature of this 'knowledge', and that the use of height in the picture plane and relative size with distance will increase as shape and size constancies become less salient. It was also suggested that the child gains experience of the aspects of objects that are relevant to the process of depiction. These points are all consistent with the view that development in depiction indirectly reflects the child's developing cognitive abilities.

Horowitz (1970) suggested that development is cyclical, in that more knowledge leads to new plans of action and new perceptual descriptions, which in turn lead to more knowledge. One might expect development in depiction to be affected by development in the ability to extract essential organising features and crucial elements of the task; in the ability to control and co-ordinate visual scanning, making it a strategic action based on task demands; and in meta-cognitive control, including planning ahead to facilitate later retrieval and executing a search according to a logical plan (Johnson-Laird 1972, Wood *et al* 1974, Chi 1978).

APPENDIX TO CHAPTER 3.

A Table Drawn from Observation.

* Data are contained in Appendix Ap.6:A.

Ap.3. Lee, M. and Bremner, G. (1987) *The representation of depth in children's drawings of a table*, The Quarterly Journal of Experimental Psychology, 39A, 479-496. Ap.3. 2

The Quarterly Journal of Experimental Psychology (1987) 39A, 479–496

The Representation of Depth in Children's Drawings of a Table

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Willats (1977) analysed developments in the drawing of a table in terms of the projection system in which the table top was represented, and concluded that representation of depth in drawing goes through a series of discrete stages, each of which can be identified with a projection system. A partial replication of Willats' study is presented here, using a much larger sample. The relationship between age and use of projection system found by Willats was in general supported. Not all the "stages" were found to be discrete, however, and an examination of the way in which the table tops were drawn shows that whilst the majority of older children appeared to use perspective, they did not use it correctly. A method is given by which tables that are drawn as if from a central viewpoint can be formally classified. It is concluded that development in the understanding of the representation of depth is not very closely linked to development in the use of projection systems.

Introduction

The way in which objects are drawn, and depth represented, differs with the subject's age and appears to develop with age in a specified manner. Willats (1977) examined this apparent development by looking at the way in which children used projection systems when they were drawing tables. A large part of this paper is devoted to following up points made

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and questions raised in Willats' work. The projection system being used by the subject is determined by examining the lines in the picture that represent the edges of the solid normal to the picture plane. These are usually termed the "orthogonals". If the orthogonals are depicted as points, the drawing is said to be in orthographic projection. The use of parallel lines indicates oblique projection. If the orthogonals are depicted as vertical lines, whilst still remaining parallel, the projection is seen as a special form of oblique and is called vertical–oblique. If the orthogonals appear to converge to a point, the solid is said to be drawn in perspective. Willats (1977) divided perspective into two categories, naive and true, depending upon the amount of convergence shown by the orthogonals.

This method of analysis is more formal than others proposed. For instance, Lowenfeld and Brittain (1966), Mitchelmore (1978; 1980), and Willats (1981) have classified development in the depiction of depth in terms of stages in the amount of realism that the artist is able to achieve. Mitchelmore classified drawings of a cuboid, a cylinder, a pyramid, and a cube in this way and found the same developmental sequences for each solid. From this he was able to predict, correctly, the way in which development would occur in the drawing of a trapezoid. However, analysis of the drawing depends to some extent upon the experimenter's interpretation both of the drawing itself, and of the situation. The beauty of an account of the representation of depth directly related to the use of projection systems comes partly from the formality of the system. By ascertaining the form of projection that is used by the child, the experimenter can identify the "stage" of depth depiction the child has achieved. The theory assumes that when children draw, they attempt to depict exactly what they see, and that as perspective is normally considered the best method of achieving this, children are working towards drawing in perspective. Willats found that the way a table top is depicted appears to develop from the use of orthographic projection, through vertical–oblique, to oblique, and finally to the use of naive or true perspective. Willats described what children do, but this does not give access to what they intend to draw, nor to rules governing the transition between systems. Freeman (1980) has suggested that what underlies transitions might be nothing more than the development of ability to produce first, a pair of right angles, second, a pair of oblique angles, and finally one oblique and one obtuse angle. In his view it is the use of these "local decisions" that determines the way in which the table is drawn, not the degree of understanding of how to represent an object in depth.

As Willats (1985) discusses at length, one major problem with his 1977 account is that it does not apply to all forms of drawing. For example, Mitchelmore describes a stage in children's drawings (Stage 3, prerealistic) in which objects are drawn as if from one viewpoint. Within this stage there is a progression from the use of one base line, through the use of several, to the use of a base plane. Depth is depicted by overlapping and size differences. Drawings in this stage do not fit comfortably into any of Willats' classifications. Similarly, Hagen (1985) identifies some forms of projection, such as divergent perspective in which the orthogonals are represented as diverging rather than converging, which are used by children but have no basis in reality. These points call into question whether analysis purely in terms of projection systems uncovers all that is taking place in development.

The assumption that the projection system in use can be derived from a table top alone is not free from doubt. The formality of this form of classification comes from the supposition that the projection system can be identified by the application of two formulae upon the angles contained in the depiction of the table top. These formulae isolate the degrees of convergence and obliquity shown by the orthogonals in the drawing. However, convergence of orthogonals is directly related to the height of the subject's eye-level. A subject looking edge-on at a table top will see it in orthographic projection. As the eye-level rises, the table top will appear in true perspective, and then naive perspective, and finally as if in vertical-oblique projection. Hence the degree of convergence does not uniquely define the projection system in use. In order to minimize ambiguity, it is necessary to examine the way in which the whole table is projected. Therefore when analysis of the drawing is confined to the way in which the table top is depicted, the psychological relevance of the way in which the projection systems are classed becomes less clear. Orthographic or vertical-oblique projection, as inferred by the form of the table top, might in reality represent a table drawn in linear perspective from an extreme viewpoint. Similarly, a distinction between naive and true perspective is not inherent in any formal method of classification. It is necessary to know something about the position of the child's eyes before one can with any validity make a distinction based only on the drawing of the table top. In fact this can only be made if the drawing has been done from observation and with a fixed eye-level, as was the case in Willats' study, and always with the assumption that the child intends to draw exactly what he or she can see.

Notice that in this scenario the object is never seen in oblique projection. For this to happen, the object would need to be viewed from the side, not the front. The implication of this point is that children appear to go through a period during which they no longer represent the table as if from the position in which they see it—the front—something they have been quite capable of doing before. Instead, they adopt an

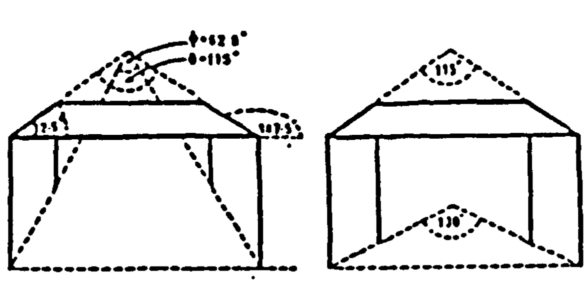
imaginary side view for a while, before reverting to their original practice of representing the table from the correct side. Alternatively, it could be argued that development is related to shifts in the viewpoint, first through a vertical rotation, then horizontal, and then back to vertical. If this were really the case, the orthogonals should converge in the oblique drawings, producing oblique perspective. Unfortunately the method of classification used by Willats was not of sufficient delicacy to pick up possible small convergences in the oblique drawings.

These points can be addressed by *examining* the manner in which the table legs as well as the table top are depicted. This is a major departure from earlier practice and makes it possible to see whether the subject uses a coherent unified projection system. For example, Figure 1a shows a table drawn correctly in perspective. The table top in Figure 1b is identical to that of Figure 1a, and classification based on the measurement of the top alone would place it as true perspective, yet it can be seen that a single, unified form of projection is not in use.

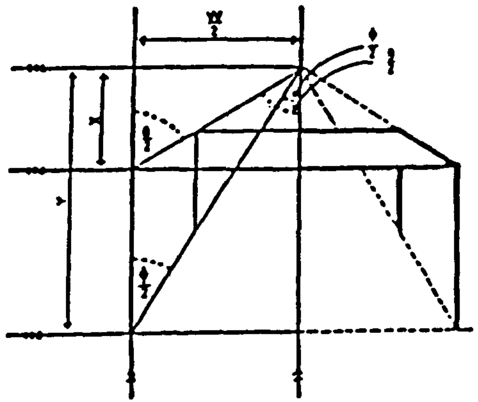
These points suggest that the belief in a stage-like progression from orthographic projection to perspective, which gives a genuine increase in complexity based only on an analysis of the way table tops are drawn, merits further examination. Further, examination of the table drawing as a whole, rather than only one aspect of it, will clarify the possibility that apparent changes in projection system may really be shifts in imagined or constructed viewpoint.

There are three areas in which Willats' experimental method might benefit from revision. First, his conclusions were based on data drawn from a sample of only eight or ten subjects of each age, and for each age these drawings are placed into one of six classes. An elbow jogged at the wrong time would make a large difference to his results. When a Kolmogorov-Smirnov two-sample test is applied to the frequencies (with age) that Willats obtained for either the use of true as opposed to naive perspective, or to the use of true perspective as opposed to the use of oblique, it can be seen that there are no significant differences between either pair. They could have occurred by chance—naive versus true perspective: $D=0.24$, $n=28$, $p>0.05$; true perspective versus oblique: $D=0.26$, $n=20$, $p>0.05$. Given the amount of variation found in children's drawings, this subject population is too small to support such a general conclusion.

The second difficulty is that Willats' experimental task was designed to study simultaneously both the use of projection systems and the use of partial occlusion. This was achieved by requiring children to draw a complicated array of objects upon the table top whilst also drawing the table. The complexity of the task may have detracted from the representativeness of his results.



1a. CORRECT PERSPECTIVE 1b. FALSE PERSPECTIVE



1c. GEOMETRIC ANALYSIS OF FIGURE 1a

Figure 1. The relationship between correct and false perspective, and a trigonometric analysis of a table drawn in perspective.

Third, although Willats controlled the overall dimensions of the table, there was variety in the shape and position of the table legs presented to the subjects. The method Willats used for classifying the drawings according to the projection systems used was based wholly on the way the table tops were drawn. There was no apparent need for control over the legs of the stimulus table, but lack of control presupposes that any differences in the legs of the tables used as stimuli would

not affect the demands of the task, and that the legs would be drawn in the same form of projection as the top. These assumptions were not verified.

Willats' study made a major contribution to the understanding of how depth is represented and also its formal classification. It has been replicated here in a modified form, because of the doubts discussed above. The stimulus table used in the present study was the same for all subjects, thus enabling direct comparison of the way in which the table legs were depicted, and the sample size was larger. The results have been examined both in terms of the projection system used and in terms of the understanding shown in its use.

Method

Subjects

Subjects consisted of 789 children, representing the total intake of one primary and one secondary school in Leyland, Lancashire. The number of subjects in each age group can be seen in Table I.

Table I

Number of Subjects in Each Age Group

Age	4	5	6	7	8	9	10	11	12	13	14
Subjects	30	30	30	30	30	30	30	147	178	164	90

Task

Each child was seated at a table facing the long side of a second table measuring 112 × 56 cm. The child's eyes were approximately 32 cm above the table top and 300 cm away from the facing table. Once settled, the child was given paper and pencil and asked to examine the surroundings of the table carefully. The child was then asked to make the best drawing he or she could of the table. No time limit was given. These conditions are very similar to those used by Willats. Figure 1a shows the view of the stimulus as seen by the subject. If a child drew more than one table, it was the first drawn that was measured.

Results

General Analysis

The drawings were assigned to classes according to the projection system in which the table top was depicted. The projection system is partially determined by the angle of convergence of the orthogonals. The same value can be obtained by drawing straight lines on the subject's picture along the line representing the front of the table and the lines representing the orthogonals of the table. The angles between these lines are measured and used to ascertain the degree of convergence by taking the smaller from the larger. For example, the table top in Figure 1a can be seen to have an angle of convergence of $147.5° - 32.5° = 115°$. This is the same method as that used by Willats (1977). Figure 1a illustrates that what is being ascertained is the angle θ made by the orthogonals as they converge to the vanishing point. In accordance with Willats' classification, all responses with a convergence of less than 20° were classified as non-perspective.

All non-perspective responses were classified according to the degree of obliquity shown, which is the mean of the two angles made by the orthogonals, and the line representing the front of the table. For example, in Figure 1a the degree of obliquity is

$$\frac{32.5+147.5}{2} = 90$$

Drawings with 0° obliquity were classed as orthographic, those between 0° and 80° were classed as oblique, those between 80° and 100° vertical-oblique, and those over 100° oblique. The margins used by Willats for vertical-oblique were 70° and 110°. The reasons for departing from these margins are discussed later. Table II gives the mean age and standard deviation for each class of projection.

Figure 2 shows the distribution of different types of class according to age. The orthographic and vertical-oblique classes show similar patterns of distribution. These two types of response, with age, were significantly correlated, $r = 0.67$, $df = 9$, $p < 0.05$, whilst also showing significant differences, $\chi^2 = 53.15$, $df = 10$, $p < 0.001$. What these findings represent is unclear, and the implications are discussed later. The proportion of children that used orthographic projection declined at the age of 7, coinciding with a rise in the use of the oblique response, but the use of both orthographic and vertical-oblique projection remained similar,

Table II

Total Number of Subjects, Average Age, and Standard Deviation of Age for Each Class of Projection

Projection	Orthographic	Vertical-Oblique	Oblique	Perspective
No. subjects	89	196	119	335
Average age	7.26	9.08	11.82	12.43
Std. deviation	2.48	2.97	1.62	1.06

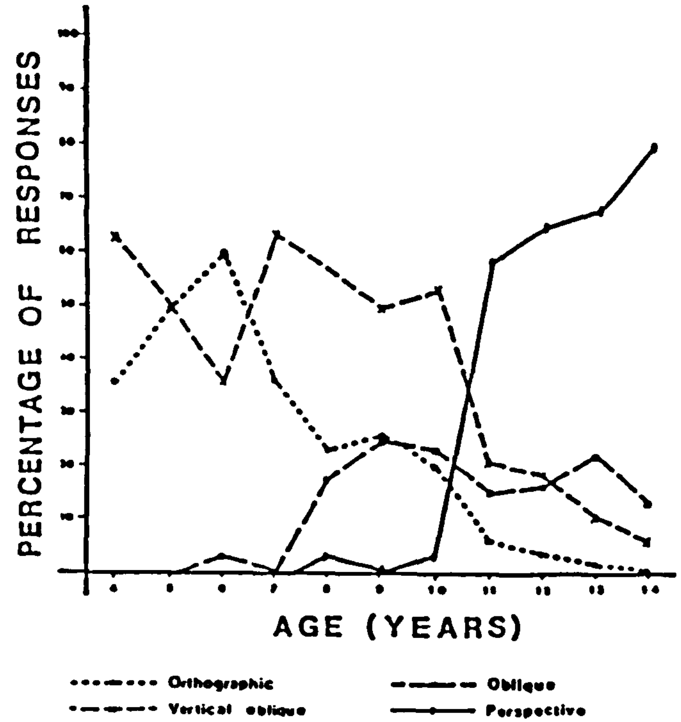


Figure 2. The proportions of use, with age, of each class of projection.

declining steadily between the ages of 10 and 11. The number of subjects in a particular age group using perspective increased from 3% at 10 years old to 80% by the age of 14, whilst from 8 years old to adulthood the use of oblique remained at between 15% and 25%.

Perspective Response

Willats arbitrarily divided the perspective response into naive and true perspective at 55° convergence. A distinction between naive and true perspective can only be made if the drawing has been done from observation, with a fixed eye-level, as is the case both here and in Willats' study. For this special case such a division would need to be supported by bi-modality in the data, or a relationship between the amount of convergence and the age of the child. Figure 3, in which frequency scores of the data at intervals of 5° convergence are given, shows no apparent bi-modality. Furthermore, a one-way ANOVA using age (in years) as a grouping factor and degrees of convergence as a dependent variable failed to show that the degree of convergence in which the table top was drawn was affected by age, $F(3,327)=2.3$, $p>0.05$. Willats (1977) found no significant correlation between the angle of convergence and age in his data. It can be concluded that there is no evidence to support a clear-cut distinction between naive and true perspective.

The view of the stimulus table that the subjects had was at 115° convergence on the top. All except two of the subjects produced drawings with a convergence on the table top of less than this. None of the subjects used linear perspective that was correct for their viewing position.

As mentioned previously, although Willats imposed strict control over the position from which the subjects drew the table and the size of table top, the legs of the tables he used varied. In this study each subject was presented with the same stimulus table, and so the depiction of the table legs can be compared across drawings. The degree of convergence shown by the legs in the drawing was measured by joining the drawn base of each front leg with a straight line, and by joining the base of each front leg to the base of the leg "behind" it by a straight line. The degree of convergence for the legs could then be calculated in the same manner

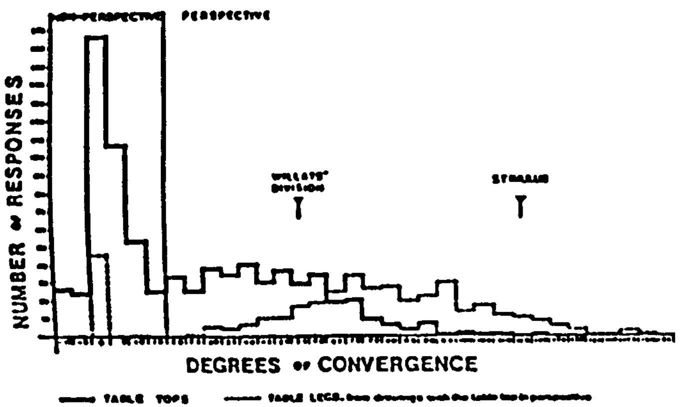


Figure 3. The distribution of data according to the degree of convergence.

as for the top. Figure 1a illustrates that what is being ascertained is the angle φ made by the inferred orthogonals as they converge to the vanishing point, 62.8° in this case. When a table in this position is drawn correctly in perspective (Figure 1a), the convergence of the legs should be less than that of the top. A drawing of a table in which the convergence of the legs is the same as or larger than that of the top (Figure 1b) is an obvious use of false perspective. In other words, when the table is drawn in correct perspective, the legs should be scaled according to the same size–distance rule.

Figure 3 shows that the convergence of the legs of those drawings whose tops were in perspective was significantly *greater* than the convergence shown by the tops, $t=21.59$, $df=331$, $p<0.05$. In three cases angle φ was 180°—in other words, the back legs were extended so far that the table gave the appearance of being on a single ground or base line. Young children do draw to a ground line; however, there was no significant difference, with age, in the degree of convergence used to depict the table legs, as shown by a one-way ANOVA using age as the grouping factor, and degrees of convergence as a dependent variable, $F(3,327)=1.5$, $p>0.05$.

Table III

Mean Degree of Convergence, by Age, for the Table Tops (θ) and the Table Legs (φ)

	11 Years	12 Years	13 Years	14 Years
θ degrees	47.08	47.36	48.48	54.26
φ degrees	84.86	87.19	81.16	80.65

Table III shows a comparison of the means obtained in the last two F tests. A perspective response was only produced by two subjects who were less than 11 years of age (8 and 10, respectively). The results for these two children are not included in this table. A posteriori tests showed no significant differences either between the means for the table tops or for the table legs, Tukey >0.05 in each case. It is possible that whilst the degrees of convergence shown both on the tops and by the legs are not age-related separately, there might be an age-related trend in the difference between the two.

A significant difference with age is found between the scores for θ and φ when a one-way ANOVA is done with age as the grouping factor and the individual differences between θ and φ as the dependent variable, $F(3,327)=3.78$, $p<0.05$. The mean differences between φ and θ for each age group are: 11-year-olds = 37.67, 12-year-olds = 39.89, 13-year-olds = 33.7, 14-year-olds = 26.37. It would appear that older children have a significant tendency to use similar angles of convergence for both the table top and the table legs. At first sight this appears paradoxical, because φ and θ are dissimilar when a table is drawn in correct perspective; however, this trend shown by the older children only partially rectifies a large amount of error in the use of these angles.

The problem is complicated by the fact that the relative dimensions of the table may not have been represented accurately. For instance, the form of perspective the child is using might be correct for the shape of the table drawn, even if that table is not an accurate representation of the "real table" in front of the child. The picture might be internally consistent, but be a bad representation. The measures used so far rely upon the child's ability to depict, correctly, the relative dimensions of the table. Figure 1c shows a geometrical analysis of half of a table in correct perspective. It can be seen that two vertical parallel lines are crossed at right angles by three parallel horizontal lines. The real orthogonal of the table top and the implied orthogonal of the table legs combine with these parallels to give two right-angled triangles. A trigonometric comparison of these triangles gives a measure of the correctness of perspective used. The logic for this is as follows: In a table in true perspective, where w is the width of the table and $y-x$ is the length of the leg (both as measured on the drawing), then

$$\begin{aligned}\cot\left(\frac{\varphi}{2}\right)-\cot\left(\frac{\theta}{2}\right)&=\frac{2y}{w}-\frac{2x}{w}\\&=\frac{2}{w}(y-x)\\&=\frac{2\times(\text{leg length})}{w}\end{aligned}$$

Each drawing can therefore be given two values: on the left-hand side, a value showing the relationship between the angles of convergence in which the table top and the table legs are represented, and on the right a value for the relative dimensions of the table. In practice, the table legs are rarely drawn the same length; therefore, height of table is taken to be the mean length of both front legs.

On the basis of the above equation, Figures 1a and 1b would be worked as follows:

Figure 1a:

$$\begin{aligned}\cot\left(\frac{62.8}{2}\right)-\cot\left(\frac{115}{2}\right)&=1.64-0.64\\&=1.00\end{aligned}$$

Figure 1b:

$$\begin{aligned}\cot\left(\frac{130}{2}\right)-\cot\left(\frac{115}{2}\right)&=0.47-0.64\\&=-0.17\end{aligned}$$

For both Figures 1a and 1b:

$$\begin{aligned}\frac{2}{w}(y-x)&=\frac{2\times 56}{112}\\&=1\end{aligned}$$

Finally, a value P can be obtained for each drawing. This represents the difference between what θ and φ should be, given the dimensions of the picture of the table, and what they actually are. Thus it is a direct measure of the internal consistency on the picture plane of the projection system used (perspective). This is a formal method of classifying tables that are represented as if from a central viewpoint (Figures 1a and 1b would have P values of $1.00-1.00=0$, and $-0.17-1=-1.17$, respectively). A table drawn in correct perspective should have a P value as near to zero as possible, constrained by the limits of the measuring equipment. The more the P value differs from this, the larger the perspective error. Variation of P value within the data was from 0.03 to -5.68. A one-way ANOVA using age (in years) as the grouping factor and value of P as the dependent variable shows that the absolute correctness of perspective used is related to age, $F(3, 327)=6.17, p<0.01$. The mean P for each age was: 11-year-olds = -1.8, 12-year-olds = -1.9, 13-year-olds = -1.7, 14-year-olds = -1.5. An examination of the mean value of P for each age group indicates that all children fail to use perspective correctly, but the perspective used by the older children is more in keeping with the dimensions of their own drawings than is that of the younger children.

Figure 4 shows the data plotted according to the two values used to obtain P. The diagonal C/D in this figure indicates all possible positions of drawings in correct perspective, given variations in the dimensions of the drawn tables. As long as it is the uppermost surface of the table that is being depicted, the only possible correct responses for any shape or size of rectangular table are those to the right of the vertical axis, i.e. those in which $\cot(\varphi/2)$ is greater than $\cot(\theta/2)$. Under the present experimental conditions point X is the only possible position of the correct response. No subjects achieved it. As proved above, it can be seen that subjects do not produce correct perspective, and that the degree of incorrect perspective produced is related to age. It is also evident in Figure 4 that these children, all of whom failed to draw perspective correctly, were reasonably good at depicting the relative

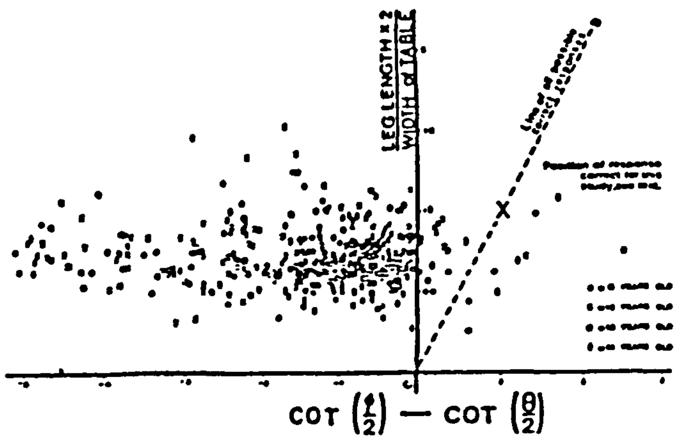


Figure 4. The relationship between age and the ability to reproduce perspective and the relative dimensions of the table correctly.

dimensions of the table, as can be seen in the way most data cluster in a vertical band near to 1.0. There is at most a mild tendency to underestimate the length of leg in relation to table width.

To summarize, those subjects producing a perspective response did not use correct perspective. In no age group is there a distinction between naive and true perspective. The table legs are drawn with a greater degree of convergence than are the tops. No subject produced a form of perspective that was correct for *any* shape of table, let alone one with the specific measurements discussed here; however, the older children were more accurate than the younger ones in their use of perspective.

Non-perspective Responses

Those drawings with less than 20° of convergence on the table top were termed non-perspective and were classified according to the degree of obliquity shown, as described earlier. Figure 3 shows that in approximately 5% of the drawings the orthogonals diverged, rather than converged. Because of the small number of such responses, they were not treated as a separate class of projection, even though physically impossible in the absence of a model whose back is longer than the front (Hagen, 1985), but were included with the other non-perspective responses.

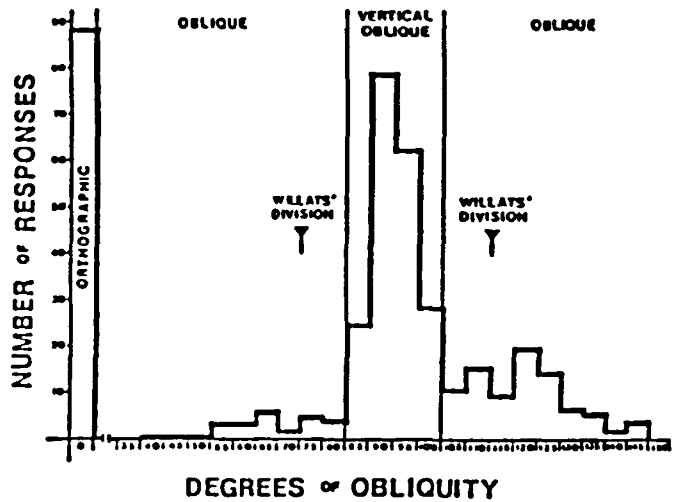


Figure 5. The distribution of data according to the degree of obliquity.

The distribution of non-perspective responses can be seen in Figure 5. The margins used by Willats were 70° and 110°. However, as can be seen in Figure 5, the limits of 80° and 100° reflect more accurately the discontinuities in the distribution obtained here. This has the effect of marginally increasing the oblique response at the expense of the vertical–oblique. However, as Figure 2 shows, the vertical–oblique response was found to be much larger than that of the oblique, and so such a narrowing of the class limits does not alter conclusions drawn from an examination of the response in these classes.

It is possible to draw a table in oblique–perspective, in which the table is shown as if viewed from the side, but with orthogonals that converge. An oblique–perspective drawing with less than 20° convergence would be classed as non-perspective in this study. This means that some drawings, classed as non-perspective, may actually be in perspective, although drawn as if viewed from the side instead of the front. Theoretically, there should be no convergence of the orthogonals in oblique projection. This was not the case for any age group. The mean convergence of the oblique response for each age group was: 8-year-olds = 4.6, 9-year-olds = 3.57, 10-year-olds = 2.33, 11-year-olds = 2.9, 12-year-olds = 4.82, 13-year-olds = 1.46, 14-year-olds = 1.5. A one-way ANOVA using age (in years) as a grouping factor and degrees convergence as dependent variable reveals no significant difference with age between these figures, $F(6, 106) = 0.65$, $p > 0.05$. These figures do not rule out the possibility that all children who produce oblique actually use oblique–perspective; however, this would appear unlikely. In this study only two children under eleven used perspective, yet eighteen used oblique. This is not consistent with a theory that relates development in the representation of depth to complexity of the projection system used. Furthermore, although there was no significant difference between the means, it would appear that the older children produce less, not more, convergence. This reversal cannot easily be explained in terms of the use of oblique–perspective but may be addressed more plausibly by Freeman's theories of figural bias, or by local decisions. Younger children are less able than older to produce two oblique parallel lines (see Mitchelmore, 1985), and the evidence presented here suggests that if a figural bias is present it will lead to the depiction of such parallel lines as converging.

Discussion

This study partially replicated that of Willats (1977) and found, as he did, that children depict a table top in a variety of ways that can be identified with the projection systems of orthographic, vertical–oblique, oblique and perspective. The major departure from techniques used earlier has been the examination of the way in which the table legs have been depicted, as well as, and in conjunction with, the way the table tops have been drawn. In this way it is possible to see whether the subject uses a coherent, unified projection system. This has enabled earlier results to be extended and earlier assumptions to be queried. Further, this study used a sufficient number of subjects to obtain a reasonable distribution. This made it possible to discover in detail how the drawing of a table from observation changes with age and showed that some distinctions previously suggested disappear.

The results presented here suggest two areas in which the class limits used by Willats require modification. The least important is the narrowing of the band in which a table top would be classed as vertical–oblique. It was shown earlier that such a narrowing of the class limits does not alter conclusions drawn from an examination of the response in these classes. The second revision, that of amalgamating naive and true perspective, has deeper implications. Theories of drawing that assume that the subject is trying to depict what is seen also assume that the best way of doing this is perspective, and that the subject is attempting to achieve a perspective result. Most importantly, they assume that adults do draw in correct perspective. It has been shown here that a distinction

between naive and true perspective cannot be supported theoretically or empirically. The representation of depth does not develop from naive to true perspective, and thus it may be appropriate to abandon this division in general, and certainly in this specific case. It has also been shown that the vast majority of subjects who drew a table in "perspective" drew the legs with more, rather than less, convergence than they had used for the table tops. This is the exact opposite of the response that would be expected from a true understanding of the projection system. The form of perspective they used was verifiably incorrect, not true, perspective, according to the formal method of measuring perspective used here, the *P* value. The *P* value is a measure of the consistency of perspective used by the subject in relation to the subject's own drawing, not as inferred by the experimenter from the stimulus. When the data are examined in this light, a developmental trend is seen, from incorrect to true perspective, according to criteria internal to the dimensions of the drawing. The oldest subjects in this study were less than 15 years old, leaving open the possibility that adults do achieve true perspective. However, Lee (submitted) found that the perspective response peaks at 14, after which age most children are no longer required to use it at school. These findings strongly support the view that although most people would argue that perspective is the theoretically correct method by which to depict depth in two dimensions, it is not necessarily the most chosen way psychologically.

In this study the oblique form of projection appears to be qualitatively different from the others. In the oblique system the table is drawn as if seen from the side, rather than as the experimental condition, "correctly" from the front. Yet in each group from eight years old to adulthood between 15% and 25% of the subjects drew a table in this form. Subjects in this age range are not normally considered so insensitive to the scene as to be incapable of showing the side from which they are in the process of viewing the table. Such a persistent use of oblique was also found by Duthie (1985), Hagen (1985) and Lee (submitted) and begs for some form of explanation. The mean degree of convergence for each age group of the oblique response was positive, whereas theoretically it should have been zero. However, it has been argued that this does not imply that subjects were using some form of oblique–perspective. Instead, it has been suggested that this aspect of the oblique response is a figural bias of the sort discussed by Freeman (1980). This leads to a testable hypothesis in a predicted direction and lends itself to further research. However, it does not solve the problem of why such a large percentage of older subjects choose to depict the table they can see in front of them in a way that is inconsistent with what they can see.

A large amount of overlap was found in the use of orthographic and vertical–oblique projection, and the patterns of response for these two classes correlated significantly. Serious doubt is cast upon the supposition that the use of these two classes indicates separate developmental stages. This doubt is supported here by the observation that those children who did draw more than one table frequently produced tables in both orthographic and vertical–oblique projection side by side on the same page. The ambiguous position of these two forms of projection is emphasized by Lee (submitted) who found that a sizeable minority of subjects who drew a table in vertical–oblique depicted objects along its top edge. Duthie (1985) reported that there were considerable variations between drawings of the same object by the same child when a child was repeatedly tested. He rejects the view that a child attempts to represent a scene in one particular form of projection. This is supported here by the finding that when a table drawing classed as vertical–oblique on the basis of the way in which its top is drawn is examined, it is frequently found that the legs are depicted in a manner inconsistent with vertical–oblique projection. As both Phillips, Inall and Lauder (1985) and Michelmore (1985) suggest, it would appear more likely that development is related to the finding and remembering of appropriate graphic descriptions rather than some general and slowly evolving conception of space. Certainly the fact that an experimenter is able to classify a drawing in a particular projection system does not necessarily indicate that the artist intended to use that system.

In conclusion, this study has shown that no subjects drew in correct perspective, that there is no clear-cut distinction between naive and true perspective, that oblique projection is qualitatively different from the other systems. The study has also cast doubt upon the supposition that orthographic and vertical–oblique projection represent separate developmental stages. These findings suggest that Willats' conclusion that the representation of depth in drawing goes through a series of discrete stages, each of which can be identified with a projection system, cannot be supported. They also suggest that the developmental processes of drawing a table are better studied in terms of skill acquisition, as the finding and remembering of appropriate graphic descriptions.

REFERENCES

Duthie, R. K. (1985). The adolescent's point of view: Studies in forms of conflict. In N. H. Freeman and M. V. Cox (Eds.), *Visual order: The nature and development of pictorial representation*. Cambridge: Cambridge University Press, pp. 101–120.

Freeman, N. H. (1980). *Strategies of representation in young children: An analysis of spatial skills and drawing processes*. London: Academic Press.

Hagen, M. A. (1985). There is no development in art. In N. H. Freeman and M. V. Cox (Eds.), *Visual order: The nature and development of pictorial representation*. Cambridge: Cambridge University Press, pp. 59–77.

Lee, M. M. (submitted). Task dependency and development in table drawing. *Perception*.

Lowenfeld, V. and Brittain, W. L. (1966). *Creative and mental growth*. New York: Macmillan.

Mitchelmore, M. C. (1978). Developmental stages in children's representation of regular solid figures. *Journal of Genetic Psychology*, 133, 229–239.

Mitchelmore, M. C. (1980). Prediction of developmental stages in the representation of regular space figures. *Journal for Research in Mathematics Education*, 11, 83–93.

Mitchelmore, M. C. (1985). Geometrical foundations of children's drawing. In N. H. Freeman and M. V. Cox (Eds.), *Visual order: The nature and development of pictorial representation*. Cambridge: University Press, pp. 289–309.

Phillips, W. A., Inall, M. and Lauder, E. (1985). On the discovery, storage and use of graphic descriptions. In N. H. Freeman and M. V. Cox (Eds.), *Visual order: The nature and development of pictorial representation*. Cambridge: Cambridge University Press, pp. 122–134.

Willats, J. (1977). How children learn to draw realistic pictures. *Quarterly Journal of Experimental Psychology*, 29, 367–382.

Willats, J. (1981). What do the marks in the picture stand for? The child's acquisition of systems of transformation and denotation. *Review of Research in Art Education*, 13, 18–33.

Willats, J. (1985). Drawing systems revisited: The role of denotation systems in children's figure drawings. In N. H. Freeman and M. V. Cox (Eds.), *Visual order: The nature and development of pictorial representation*. Cambridge: Cambridge University Press, pp. 78–100.

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APPENDIX TO CHAPTER 4.

A Table Drawn from Imagination.

* Data are contained in Appendix Ap.6:B.

APPENDIX TO CHAPTER 5.

Aspects of the task causing task dependency.

* Data are contained in Chapter 5.

APPENDICES TO CHAPTER 6.

Classification of Table Drawings and the Use of Depth Cues.

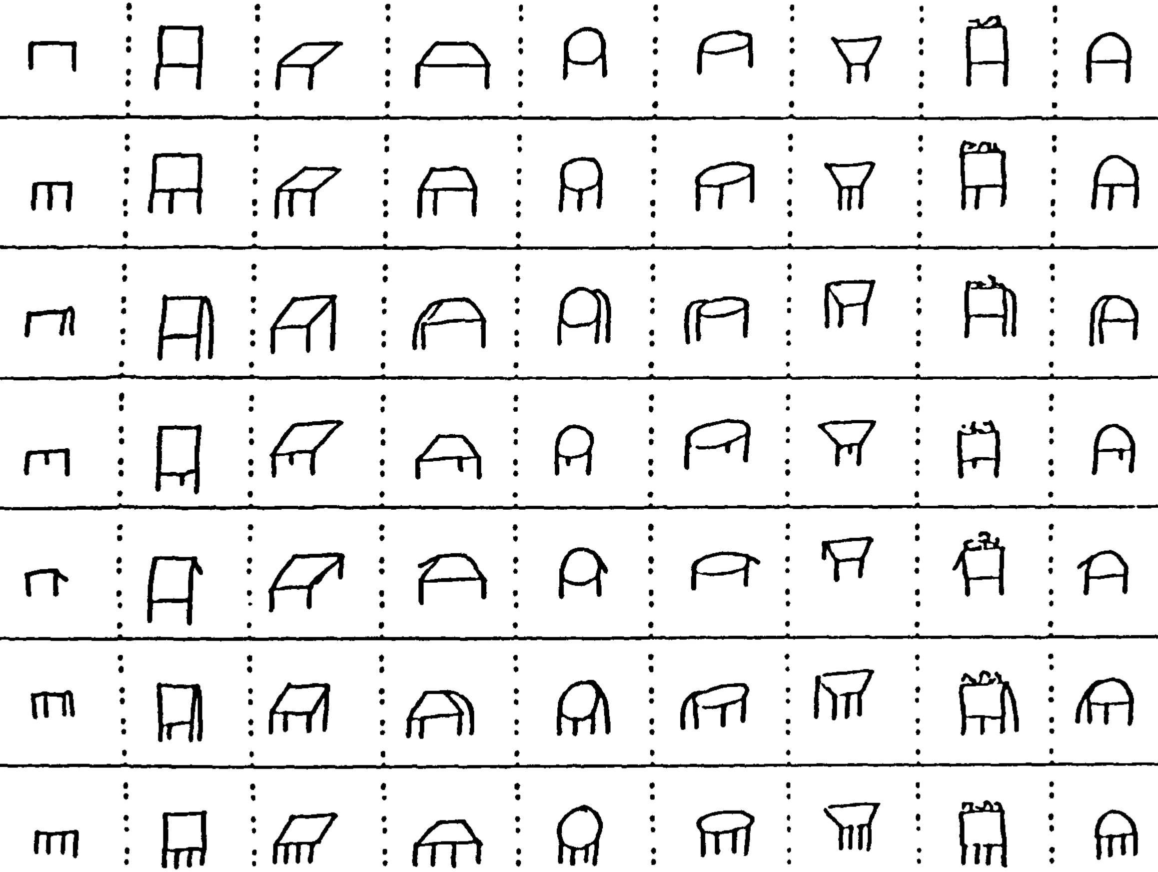
Introduction.

Table 1 presents a system by which drawings of tables can be classified. The form of projection used upon the table top is given along the horizontal axis and the way in which the table legs are drawn is given along the vertical axis. Therefore a table drawn like this:  would be placed in cell 1a.

Table 2 has two functions. Firstly the data discussed in Chapters 3 and 4 (and given in appendices 6:A and 6:B respectively) are presented for each cell. Underneath the drawing within each cell there are three columns. The first column gives details for tables drawn from observation (Chapter 3), The second gives details for tables drawn from imagination (Chapter 4), and the third gives details for both sets of data amalgamated together. Within each column, hence for each set of data, the total percentage of responses accounted for by that cell is given, as is the mean age and standard deviation of age of subjects responding in that cell.

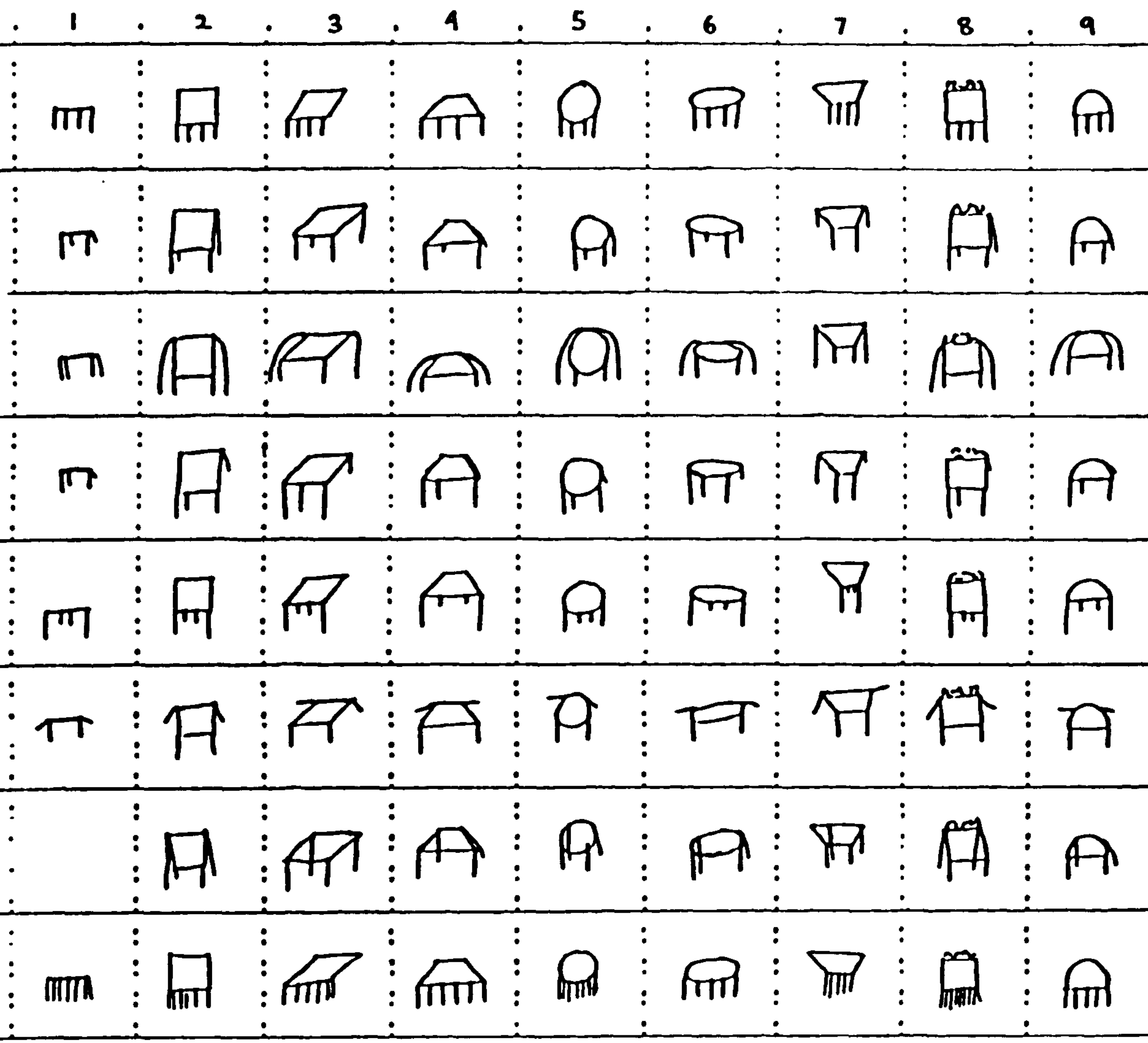
The second function served by Table 2 is that of classifying the form of depth response indicated by the way in which the table legs are drawn. This is shown by the figures to the right of the picture in each cell. Thus each cell contains a rating for height in the picture plane (H), partial occlusion (O), and diminishing size with distance (D). The depth cue of height in the picture plane is divided into four categories, namely:- no ground line (H1), plan view (H2), ground line (H3) and ground plane (H4). The depth cue of occlusion is divided into three categories, namely:- no occlusion (O1), lack of hidden line elimination (O2) and partial occlusion (O3). No subjects used diminishing size with distance on the table legs therefore the only category for this depth cue is no diminishing size with distance (D1). Some cells present problems when categorised in this way. In those instances both possible categories have been given, but it is the one presented in brackets that is adopted for later analysis.

TABLE 1. Classification system for table drawings.



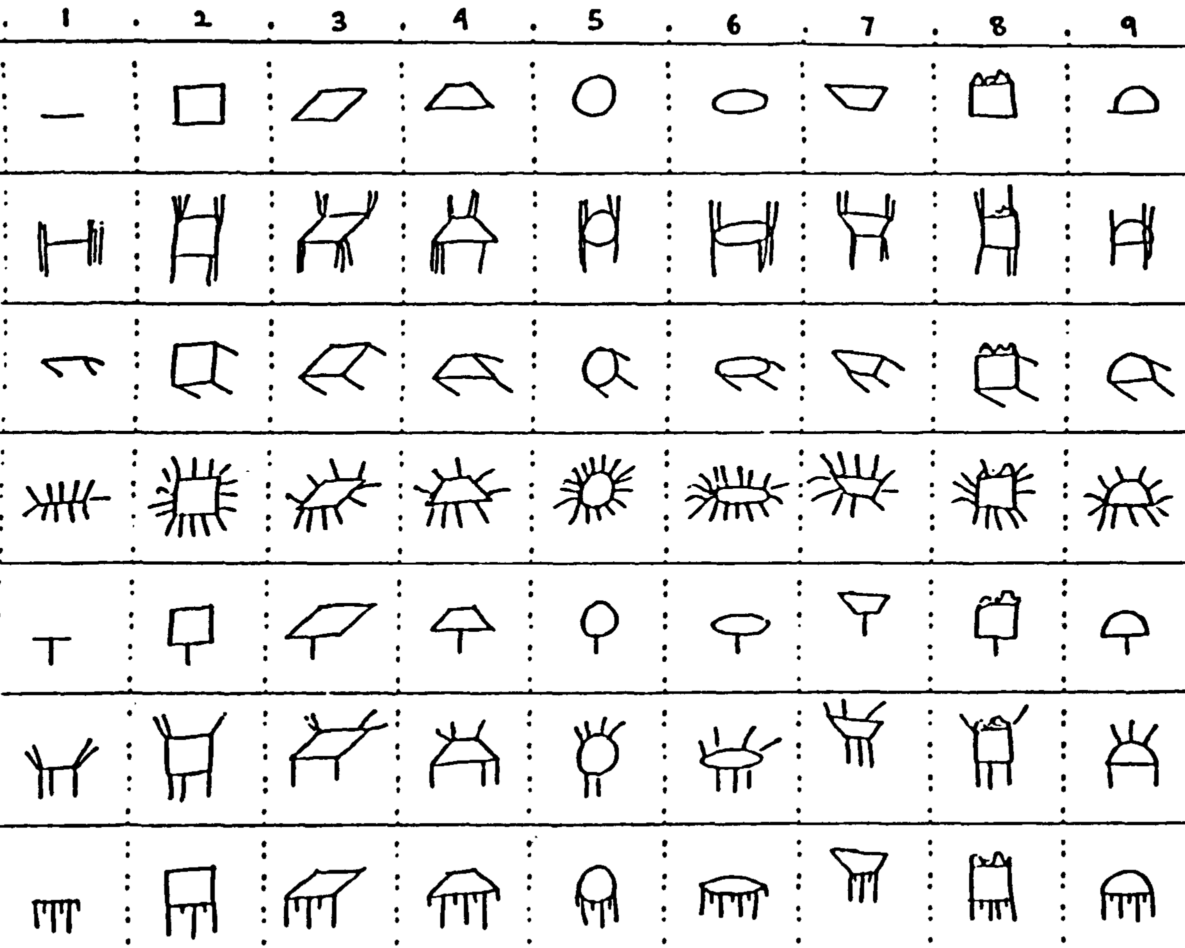
	ORTHO GRAPHIC	VERTICAL OBLIQUE	OBLIQUE	PERS-PECTIVE	ROUND	OVAL	INVERSE PERS-PECTIVE	ORTHO-GRAPHIC/ VERTICAL OBLIQUE	SEMI-CIRCLE	DESCRIPTION
	1	2	3	4	5	6	7	8	9	
a										:Two legs are drawn, :one from each front corner
b										:A third leg is drawn :between the first two, :all end level.
c										:A third leg is drawn from the :back, outside the first two.
d										:The third leg is between the :first two, and ends higher in :the picture plane.
e										:The third leg comes from the :back, outside the first two. :Ends higher in picture plane.
f										:As b but fourth leg comes from :back, outside others. All end :level.
g										:All four legs come from the :front line and all finish :level.

TABLE 1. Continued.



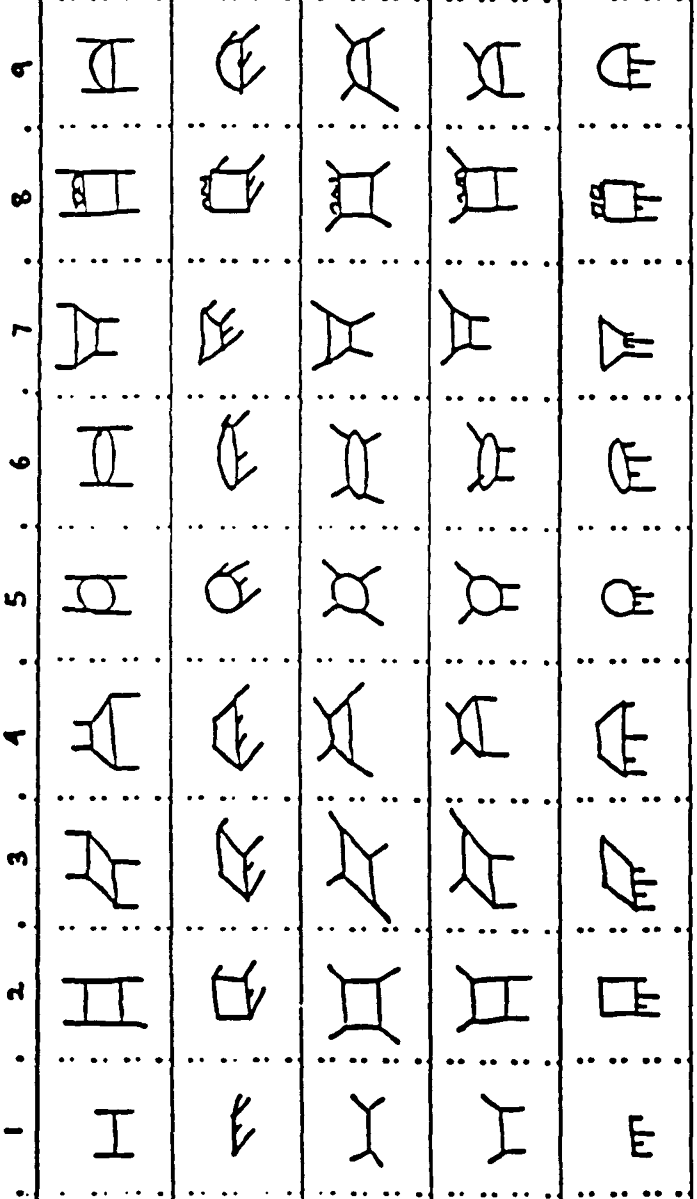
g	All four legs come from the front line and all finish level.
h	The four legs are equal length, and come from the corners. Near vertical with one leg inside
i	As c but the fourth leg comes from the back, outside the others. All finish level.
j	As d but the fourth leg comes from the back, ending higher than the other back leg
k	The back legs come between the first two and are shorter.
l	As h, but the back two legs ar drawn outside the figure an are not vertical.
m	As h, but drawn as a transparancy.
n	As g, but with more than four legs.

TABLE 1. Continued.



o	Only the top of the table is drawn.
p	As v, but with more than four legs.
q	As e, but the legs are drawn on the diagonal.
r	As x, but with more than four legs.
s	A single leg from the center.
t	As y, but with more than four legs.
u	As z, but with more than four legs.

TABLE 1. Continued.



v	The four legs come from the corners, as straight lines either vertical or horizontal.
w	As q, but fourth leg as in k.
x	The four legs radiate from the corners.
y	The four legs come from the corners, the back two radiate whilst the front are vertical.
z	The four legs come from the front edge and are alternately long and short.

TABLE 2. Classification of data discussed in Chapter 6.

TABLE TOP	ORTHOGRAPHIC			VERTICAL OBLIQUE			OBLIQUE			PERSPECTIVE			ROUND			OVAL			INVERSE PERSPECTIVE			ORTHOGRAPHIC/ VERTICAL OBLIQUE			SEMI-CIRCLE		
DATA FROM:- OBSERVATION, IMAGINATION, OR BOTH STUDIES:	1			2			3			4			5			6			7			8			9		
	OB.	IM.	BOTH	OB.	IM.	BOTH	OB.	IM.	BOTH	OB.	IM.	BOTH	OB.	IM.	BOTH	OB.	IM.	BOTH	OB.	IM.	BOTH	OB.	IM.	BOTH	OB.	IM.	BOTH
a			H3 01 D1			H3 01 D1			H3 01 D1			H3 01 D1			H3 01 D1			H3 01 D1			H3 01 D1			H3 01 D1			H3 01 D1
% OF TOTAL	6.6	13.	12.	3.7	4.4	4.3	0.5	0.3	0.3	1.9	0.7	0.9		0.7	0.5		0.3	0.3		.02	.02		0.6	0.5			
MEAN AGE	6.5	7.5	7.4	7.5	7.7	7.7	12.	12.	12.	12.	12.	12.		5.5	5.5		7.8	7.8		7.0	7.0		6.6	6.6			
STANDARD DEVIATION	2.3	2.7	2.7	3.1	2.4	2.5	1.3	2.2	2.0	1.2	2.0	1.7		2.5	2.5		3.1	3.1		0	0		2.3	2.3			
b			H3 01 D1			H3 01 D1			H3 01 D1			H3 01 D1			H3 01 D1			H3 01 D1			H3 01 D1			H3 01 D1			H3 01 D1
% OF TOTAL	0.3	0.4	0.3	0.6	0.6	0.6		.07	.06					0.2	0.1		0.2	0.2								.05	.04
MEAN AGE	6.5	7.6	7.5	6.0	6.2	6.2		11.	11.					4.5	4.5		11.	11.								6.0	6.0
STANDARD DEVIATION	2.1	2.7	2.6	3.4	1.7	2.0		1.0	1.0					0.8	0.8		7.4	7.4								1.4	1.4
c			H3 01 D1			H3 01 D1			H3 01 D1			H3 01 D1			H3 01 D1			H3 01 D1			H3 01 D1			H3 01 D1			H3 01 D1
% OF TOTAL								.07	.06																		
MEAN AGE								8.3	8.3																		
STANDARD DEVIATION								2.3	2.3																		
d			H4 01(3) D1			H4 03 D1			H4 03 D1			H4 03 D1			H4 03 D1			H4 03 D1			H4 O(1)3 D1			H4 O(1)3 D1			H4 03 D1
% OF TOTAL		.02	.02	0.5		.08	0.1		.02	1.9		0.3															
MEAN AGE		14.	14.0	12.		12.	12.		12.	12.		12.															
STANDARD DEVIATION		0	0	0		0	0		0	0.5		0.5															
e			H4 01 D1			H4 01 D1			H4 01 D1			H4 01 D1			H4 01 D1			H4 01 D1			H4 01 D1			H4 01 01			H4 01 D1
% OF TOTAL		.02	.02	0.6	1.0	1.0	1.3	5.6	4.9		.02	.02		.02	.02												
MEAN AGE		7.0	7.0	11.	10.	10.	11.	11.	11.		10.	10.		8.0	8.0												
STANDARD DEVIATION		0	0	1.5	1.7	1.6	1.9	5.2	5.1		0	0		0	0												

TABLE 2. Continued.

TABLE TOP	ORTHOGRAPHIC			VERTICAL OBLIQUE			OBLIQUE			PERSPECTIVE			ROUND			OVAL			INVERSE PERSPECTIVE			ORTHOGRAPHIC/ VERTICAL OBLIQUE			SEMI-CIRCLE		
DATA FROM - OBSERVATION, IMAGINATION, OR BOTH STUDIES:	1			2			3			4			5			6			7			8			9		
	OB.	IM.	BOTH	OB.	IM.	BOTH	OB.	IM.	BOTH	OB.	IM.	BOTH	OB.	IM.	BOTH	OB.	IM.	BOTH	OB.	IM.	BOTH	OB.	IM.	BOTH	OB.	IM.	BOTH
f			N3 O(1)3 D1			N3 O1(3) D1			N3 O1(3) D1			N3 O1(3) D1			N3 O1(3) D1			N3 O1(3) D1			N3 O(1)3 D1			N3 O(1)3 D1			N3 O1(3) D1
% OF TOTAL				0.1	0.1	0.1	0.4	0.8	0.8																		
MEAN AGE				6.0	10.	9.8	11.	11.	11.																		
STANDARD DEVIATION				0	1.0	1.9	1.2	2.4	2.3																		
g			N3 O1 D1			N3 O1 D1			N3 O1 D1			N3 O1 D1			N3 O1 D1			N3 O1 D1			N3 O1 D1			N3 O1 D1			N3 O1 D1
% OF TOTAL	3.4	7.5	6.9	6.7	7.1	7.0	0.3	.02	02	0.3	.04	.03		1.0	0.8		1.4	1.2		0.1	0.1		0.7	0.6		.07	.06
MEAN AGE	7.6	7.5	7.5	7.3	7.2	7.2	12.	11.	11.	12.	12.	12.		6.4	6.4		7.7	7.7		7.5	7.5		6.8	6.8		6.3	6.3
STANDARD DEVIATION	2.1	2.0	2.0	2.3	1.9	1.9	0.7	2.1	1.9	1.4	7.2	6.7		1.9	1.9		1.7	1.7		1.0	1.0		1.6	1.6		1.5	1.5
h			N4 O(1)3 D1			N4 O1(3) D1			N4 O1(3) D1			N4 O1(3) D1			N4 O1(3) D1			N4 O1(3) D1			N4 O(1)3 D1			N4 O(1)3 D1			N4 O1(3) D1
% OF TOTAL				1.7	0.4	0.6	6.0	14.	13.	1.1	0.1	0.3		0.1	0.1		.05	.04		0.4	0.3						
MEAN AGE				10.	10.	10.	12.	14.	14.	12.	12.	12.		9.6	9.6		9.0	9.0		9.1	9.1						
STANDARD DEVIATION				1.8	2.3	2.0	1.5	6.0	5.9	0.9	1.2	1.0		1.5	1.5		1.4	1.4		1.6	1.6						
i			N3 O1 D1			N3 O1 D1			N3 O1 D1			N3 O1 D1			N3 O1 D1			N3 O1 D1			N3 O1 D1			N3 O1 D1			N3 O1 D1
% OF TOTAL				0.1	.07	.08																					
MEAN AGE				6.0	6.7	6.5																					
STANDARD DEVIATION				0	0.6	0.6																					
j			N4 O(1)3 D1			N4 O1(3) D1			N4 O1(3) D1			N4 O1(3) D1			N4 O1(3) D1			N4 O1(3) D1			N4 O1 D1			N4 O(1)3 D1			N4 O1(3) D1
% OF TOTAL		.02	.02	0.6	0.8	0.8	4.4	7.3	6.8	0.1	.05	.06		.02	.02												
MEAN AGE		12.	12.	11.	11.	11.	11.	12.	12.	11.	11.	11.		9.0	9.0												
STANDARD DEVIATION		0.	0.	0.8	2.0	1.9	1.8	5.0	4.8	0	0	0		0	0												

TABLE 2. Continued.

TABLE TOP	ORTHOGRAPHIC			VERTICAL OBLIQUE			OBLIQUE		
DATA FROM:- OBSERVATION, IMAGINATION, OR BOTH STUDIES:	1			2			3		
	OB.	IM.	BOTH	OB.	IM.	BOTH	OB.	IM.	BOTH
k			H4 O(1)3 D1			H4 O3 D1			H4 O1(3) D1
% OF TOTAL	1.0	2.0	1.9	7.9	4.8	5.3	2.2	0.4	0.7
MEAN AGE	11.	9.6	9.7	11.	10.	10.	13.	12.	12.
STANDARD DEVIATION	1.3	2.0	2.0	1.9	2.8	2.7	0.8	1.7	1.4
l			H2(4) O1 D1			H2(4) O1 D1			H2(4) O1 D1
% OF TOTAL				0.3	3.4	2.9			
MEAN AGE				11.	9.3	9.3			
STANDARD DEVIATION				0	1.7	1.7			
m			H4 O2 D1			H4 O2 D1			H4 O2 D1
% OF TOTAL				0.5	0.4	0.4		0.3	0.3
MEAN AGE				10.	8.7	8.9		11.	11.
STANDARD DEVIATION				1.0	2.9	2.7		1.5	1.5
n			H3 O1 D1			H3 O1 D1			H3 O1 D1
% OF TOTAL		0.8	0.7		1.1	0.9			
MEAN AGE		5.3	5.3		5.4	5.4			
STANDARD DEVIATION		1.7	1.7		1.1	1.1			
o			H1 O1 D1			H1 O1 D1			H1 O1 D1
% OF TOTAL				0.3	1.0	0.9		.02	.02
MEAN AGE				4.5	8.1	7.9		10.	10.
STANDARD DEVIATION				0.7	4.4	4.4		0	0

TABLE TOP	PERSPECTIVE			ROUND			OVAL		
DATA FROM:- OBSERVATION, IMAGINATION, OR BOTH STUDIES:	4			5			6		
	OB.	IM.	BOTH	OB.	IM.	BOTH	OB.	IM.	BOTH
k			H4 O3 D1			H4 O3 D1			H4 O3 D1
% OF TOTAL	43.	4.4	11.		0.2	0.2		0.6	0.5
MEAN AGE	12.	12.	12.		10.	10.		11.	11.
STANDARD DEVIATION	1.1	3.0	2.0		1.7	1.7		3.4	3.4
l			H2(4) O1 D1			H2(4) O1 D1			H2(4) O1 D1
% OF TOTAL		.02	.02		.05	.04		0.2	0.1
MEAN AGE		11.	11.		8.0	8.0		8.8	8.8
STANDARD DEVIATION		0	0		1.4	1.4		1.6	1.6
m			H4 O2 D1			H4 O2 D1			H4 O2 D1
% OF TOTAL		.02	.02		.02	.02			
MEAN AGE		11.	11.		12.	12.			
STANDARD DEVIATION		0	0		0	0			
n			H3 O1 D1			H3 O1 D1			H3 O1 D1
% OF TOTAL					0.5	0.4		0.1	0.1
MEAN AGE					4.4	4.4		7.2	7.2
STANDARD DEVIATION					1.5	1.5		3.5	3.5
o			H1 O1 D1			H1 O1 D1			H1 O1 D1
% OF TOTAL					0.6	0.6		.05	.04
MEAN AGE					3.7	3.7		5.0	5.0
STANDARD DEVIATION					1.9	1.9		1.4	1.4

TABLE TOP	INVERSE PERSPECTIVE			ORTHOGRAPHIC/ VERTICAL OBLIQUE			SEMI-CIRCLE		
DATA FROM:- OBSERVATION, IMAGINATION, OR BOTH STUDIES:	7			8			9		
	OB.	IM.	BOTH	OB.	IM.	BOTH	OB.	IM.	BOTH
k			H4 O1(3) D1			H4 O1(3) D1			H4 O3 D1
% OF TOTAL		.05	.04		0.1	0.1			
MEAN AGE		9.5	9.5		7.2	7.2			
STANDARD DEVIATION		0.7	0.7		1.5	1.5			
l			H2(4) O1 D1			H2(4) O1 D1			H2(4) O1 D1
% OF TOTAL									
MEAN AGE									
STANDARD DEVIATION									
m			H4 O2 D1			H4 O1(2) D1			H4 O2 D1
% OF TOTAL									
MEAN AGE									
STANDARD DEVIATION									
n			H3 O1 D1			H3 O1 D1			H3 O1 D1
% OF TOTAL					0.1	0.1			
MEAN AGE					6.0	6.0			
STANDARD DEVIATION					0.8	0.8			
o			H1 O1 D1			H1 O1 D1			H1 O1 D1
% OF TOTAL		.02	.02					.02	.02
MEAN AGE		8.0	8.0					4.0	4.0
STANDARD DEVIATION		0	0					0	0

TABLE 2. Continued.

TABLE TOP	ORTHOGRAPHIC 1 OB.	IM.	BOTH	VERTICAL OBLIQUE 2 OB.	IM.	BOTH	OBLIQUE 3 OB.	IM.	BOTH
p			H2 01 D1			H2 01 D1			H2 01 D1
% OF TOTAL					0.2	0.2			
MEAN AGE					6.2	6.2			
STANDARD DEVIATION					1.2	1.2			
q			H1(4) 01 D1			H1(4) 01 D1			H1(4) 01 D1
% OF TOTAL		.02	.02		0.5	0.4		0.1	.09
MEAN AGE		8.0	8.0		11.	11.		10.	10.
STANDARD DEVIATION		0	0		1.7	1.7		2.1	2.1
r			H1 01 D1			H1 01 D1			H1 01 D1
% OF TOTAL					0.2	0.2			
MEAN AGE					4.4	4.4			
STANDARD DEVIATION					0.5	0.5			
s			H3 01 D1			H3 01 D1			H3 01 D1
% OF TOTAL		.05	.04					.05	.04
MEAN AGE		13.	13.					16.	16.
STANDARD DEVIATION		1.4	1.4					6.4	6.4
t			H(2)3 01 D1			H(2)3 01 D1			H(2)3 01 D1
% OF TOTAL					.05	.04			
MEAN AGE					6.5	6.5			
STANDARD DEVIATION					2.1	2.1			

TABLE TOP	PERSPECTIVE 4 OB.	IM.	BOTH	ROUND 5 OB.	IM.	BOTH	OVAL 6 OB.	IM.	BOTH
p			H2 01 D1			H2 01 D1			H2 01 D1
% OF TOTAL					.02	.02			
MEAN AGE					7.0	7.0			
STANDARD DEVIATION					0	0			
q			H1(4) 01 D1			H1(4) 01 D1			H1(4) 01 D1
% OF TOTAL									
MEAN AGE									
STANDARD DEVIATION									
r			H1 01 D1			H1 01 D1			H1 01 D1
% OF TOTAL					0.9	0.8		.02	.02
MEAN AGE					4.7	4.7		3.0	3.0
STANDARD DEVIATION					1.2	1.2		0	0
s			H3 01 D1			H3 01 D1			H3 01 D1
% OF TOTAL					0.4	0.3		0.4	0.3
MEAN AGE					6.6	6.6		11.	11.
STANDARD DEVIATION					3.2	3.2		4.6	4.6
t			H(2)3 01 D1			H(2)3 01 D1			H(2)3 01 D1
% OF TOTAL									
MEAN AGE									
STANDARD DEVIATION									

TABLE TOP	INVERSE PERSPECTIVE 7 OB.	IM.	BOTH	ORTHOGRAPHIC/VERTICAL OBLIQUE 8 OB.	IM.	BOTH	SEMI-CIRCLE 9 OB.	IM.	BOTH
p			H2 01 D1			H2 01 D1			H2 01 D1
% OF TOTAL									
MEAN AGE									
STANDARD DEVIATION									
q			H1(4) 01 D1			H1(4) 01 D1			H1(4) 01 D1
% OF TOTAL									
MEAN AGE									
STANDARD DEVIATION									
r			H2 01 D1			H1 01 D1			H1 01 D1
% OF TOTAL									
MEAN AGE									
STANDARD DEVIATION									
s			H3 01 D1			H3 01 D1			H3 01 D1
% OF TOTAL									
MEAN AGE									
STANDARD DEVIATION									
t			H(2)3 01 D1			H(2)3 01 D1			H(2)3 01 D1
% OF TOTAL									
MEAN AGE									
STANDARD DEVIATION									

TABLE 2. Continued.

TABLE TOP	ORTHOGRAPHIC			VERTICAL OBLIQUE			OBLIQUE			PERSPECTIVE			ROUND			OVAL			INVERSE PERSPECTIVE			ORTHOGRAPHIC/: VERTICAL OBLIQUE			SEMI-CIRCLE		
DATA FROM:- OBSERVATION, IMAGINATION, OR BOTH STUDIES:	1			2			3			4			5			6			7			8			9		
	OB.	IM.	BOTH	OB.	IM.	BOTH	OB.	IM.	BOTH	OB.	IM.	BOTH	OB.	IM.	BOTH	OB.	IM.	BOTH	OB.	IM.	BOTH	OB.	IM.	BOTH	OB.	IM.	BOTH
w			H4 O(1)3 D1			H4 O1(3) D1			H4 O(1)3 D1			H4 O(1)3 D1			H4 O1(3) D1			H4 O1(3) D1			H4 O(1)3 D1			H4 O(1)3 D1			H4 O1(3) D1
% OF TOTAL																	.02	.02					.02	.02			
MEAN AGE																	14.	14.					7.0	7.0			
STANDARD DEVIATION																	0	0					0	0			
v			H(2)3 O1 D1			H(2)3 O1 D1			H(2)3 O1 D1			H(2)3 O1 D1			H(2)3 O1 D1			H(2)3 O1 D1			H(2)3 O1 D1			H(2)3 O1 D1			H(2)3 O1 D1
% OF TOTAL				1.1	2.3	2.2								0.2	0.2		.02	.02									
MEAN AGE				7.1	7.0	7.0								6.4	6.4		9.0	9.0									
STANDARD DEVIATION				2.7	2.0	2.1								2.6	2.6		0	0									
x			H1(2) O1 D1			H1(2) O1 D1			H1(2) O1 D1			H1(2) O1 D1			H1(2) O1 D1			H1(2) O1 D1			H1(2) O1 D1			H1(2) O1 D1			H1(2) O1 D1
% OF TOTAL					0.7	0.6								0.5	0.4												
MEAN AGE					7.9	7.9								5.8	5.8												
STANDARD DEVIATION					1.5	1.5								1.2	1.2												
y			H(2)3 O1 D1			H(2)3 O1 D1			H(2)3 O1 D1			H(2)3 O1 D1			H(2)3 O1 D1			H(2)3 O1 D1			H(2)3 O1 D1			H(2)3 O1 D1			H(2)3 O1 D1
% OF TOTAL					0.4	0.3				0.1		.02		0.1	.08												
MEAN AGE					7.2	7.2				12.		12.		5.8	5.8												
STANDARD DEVIATION					1.4	1.4				0		0		1.5	1.5												
z			H4 O(1)3 D1			H4 O(1)3 D1			H4 O(1)3 D1			H4 O(1)3 O1			H4 O3 D1			H4 O3 D1			H4 O(1)3 D1			H4 O(1)3 D1			H4 O(1)3 D1
% OF TOTAL		0.2	0.2	0.1	0.3	0.2		.02	.02					0.1	.08		0.3	0.2									
MEAN AGE		10.	10.	11.	10.	10.		11.	11.					9.8	9.8		16.	16.									
STANDARD DEVIATION		1.5	1.5.	0	2.0	1.9		0	0					1.3	1.3		10.	10.									

Appendix 6: A.

Data for tables drawn from observation.

This appendix presents the data discussed in Chapter 3, classified according to the method given in Table 1. The total subject numbers, average age, standard deviation of age and percentage of the total response, summed over age, are given for each cell. The percentage response for each age group, is then given.

Appendix 6:Aa. Subject totals for tables drawn from observation.
Appendix 6:Ab. Average ages for tables drawn from observation.

SUBJECT TOTALS

	1	2	3	4	5	6	7	8	9	Total
a	52	29	4	15	0	0	0	0	0	100
b	2	5	0	0	0	0	0	0	0	7
c	0	0	0	0	0	0	0	0	0	0
d	0	4	1	15	0	0	0	0	0	20
e	0	5	10	0	0	0	0	0	0	15
f	0	1	3	0	0	0	0	0	0	4
g	27	53	2	2	0	0	0	0	0	84
h	0	13	47	9	0	0	0	0	0	69
i	0	1	0	0	0	0	0	0	0	1
j	0	5	35	1	0	0	0	0	0	41
k	8	62	17	342	0	0	0	0	0	429
l	0	2	0	0	0	0	0	0	0	2
m	0	4	0	0	0	0	0	0	0	4
n	0	0	0	0	0	0	0	0	0	0
o	0	2	0	0	0	0	0	0	0	2
p	0	0	0	0	0	0	0	0	0	0
q	0	0	0	0	0	0	0	0	0	0
r	0	0	0	0	0	0	0	0	0	0
s	0	0	0	0	0	0	0	0	0	0
t	0	0	0	0	0	0	0	0	0	0
u	0	0	0	0	0	0	0	0	0	0
v	0	9	0	0	0	0	0	0	0	9
w	0	0	0	0	0	0	0	0	0	0
x	0	0	0	0	0	0	0	0	0	0
y	0	0	0	1	0	0	0	0	0	1
z	0	1	0	0	0	0	0	0	0	1
tot	89	196	119	385	0	0	0	0	0	789

AVERAGE AGES

	1	2	3	4	5	6	7	8	9	
a	6.52	7.48	12.25	12.33	0.00	0.00	0.00	0.00	0.00	7.90
b	6.50	6.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.14
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.00	12.00	12.00	12.00	0.00	0.00	0.00	0.00	0.00	12.00
e	0.00	10.80	11.10	0.00	0.00	0.00	0.00	0.00	0.00	11.00
f	0.00	6.00	9.67	0.00	0.00	0.00	0.00	0.00	0.00	8.75
g	7.63	7.26	11.50	12.00	0.00	0.00	0.00	0.00	0.00	7.60
h	0.00	9.92	12.13	12.11	0.00	0.00	0.00	0.00	0.00	11.71
i	0.00	6.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00
j	0.00	11.20	11.31	11.00	0.00	0.00	0.00	0.00	0.00	11.29
k	11.00	11.34	12.71	12.46	0.00	0.00	0.00	0.00	0.00	12.28
l	0.00	11.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.00
m	0.00	9.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.75
n	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
o	0.00	4.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.50
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
q	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
r	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
s	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	7.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.11
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
y	0.00	0.00	0.00	12.00	0.00	0.00	0.00	0.00	0.00	12.00
z	0.00	11.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.00
	7.26	9.08	11.82	12.43	0.00	0.00	0.00	0.00	0.00	

Appendix 6:Ac. Standard deviations of age for tables drawn from observation.
Appendix 6:Ad. Percentage of total response, summed over age, for tables drawn from observation.

STANDARD DEVIATIONS OF AGES

	1	2	3	4	5	6	7	8	9	
a	2.30	3.11	1.26	1.18	0.00	0.00	0.00	0.00	0.00	3.24
b	2.12	3.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.91
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.00	0.00	0.00	0.53	0.00	0.00	0.00	0.00	0.00	0.46
e	0.00	1.48	1.91	0.00	0.00	0.00	0.00	0.00	0.00	1.73
f	0.00	0.00	1.15	0.00	0.00	0.00	0.00	0.00	0.00	2.06
g	2.08	2.32	0.71	1.41	0.00	0.00	0.00	0.00	0.00	2.38
h	0.00	1.61	1.48	0.93	0.00	0.00	0.00	0.00	0.00	1.67
i	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
j	0.00	0.84	1.81	0.00	0.00	0.00	0.00	0.00	0.00	1.69
k	1.31	1.90	0.77	1.08	0.00	0.00	0.00	0.00	0.00	1.30
l	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
m	0.00	0.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.96
n	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
o	0.00	0.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.71
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
q	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
r	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
s	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	2.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.71
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
y	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
z	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2.48	2.97	1.62	1.06	0.00	0.00	0.00	0.00	0.00	

Percentage of grand total, summed over age

	1	2	3	4	5	6	7	8	9	
a	6.59	3.68	0.51	1.90	0.00	0.00	0.00	0.00	0.00	12.67
b	0.25	0.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.89
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.00	0.51	0.13	1.90	0.00	0.00	0.00	0.00	0.00	2.53
e	0.00	0.63	1.27	0.00	0.00	0.00	0.00	0.00	0.00	1.90
f	0.00	0.13	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.51
g	3.42	6.72	0.25	0.25	0.00	0.00	0.00	0.00	0.00	10.65
h	0.00	1.65	5.96	1.14	0.00	0.00	0.00	0.00	0.00	8.75
i	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
j	0.00	0.63	4.44	0.13	0.00	0.00	0.00	0.00	0.00	5.20
k	1.01	7.86	2.15	43.35	0.00	0.00	0.00	0.00	0.00	54.37
l	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25
m	0.00	0.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.51
n	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
o	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
q	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
r	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
s	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	1.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.14
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
y	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.13
z	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
	11.28	24.84	15.08	48.80	0.00	0.00	0.00	0.00	0.00	%100.00

Appendix 6:Ae. Percentage response for each age group for tables drawn from observation.

Percentage of grand total. Age= 5

	1	2	3	4	5	6	7	8	9	
a	1.52	0.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.03
b	0.13	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
f	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
g	0.25	0.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.14
h	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
i	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
j	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
k	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
l	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
n	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
o	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
q	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
r	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
s	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
y	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
z	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1.90	1.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.80

Percentage of grand total. Age= 4

	1	2	3	4	5	6	7	8	9	
a	1.27	0.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.03
b	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
f	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
g	0.13	0.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.01
h	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
i	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
j	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
k	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
l	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
n	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
o	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
q	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
r	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
s	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
y	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
z	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1.39	2.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.80

Appendix 6:Ae. Continued.

Percentage of grand total. Age= 6

	1	2	3	4	5	6	7	8	9	
a	1.27	0.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.77
b	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
f	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
g	0.89	0.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.52
h	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
i	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
j	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.13
k	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
l	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
n	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
q	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
r	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
s	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
y	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
z	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2.15	1.52	0.13	0.00	0.00	0.00	0.00	0.00	0.00	3.80

Percentage of grand total. Age= 7

	1	2	3	4	5	6	7	8	9	
a	0.89	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.27
b	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
f	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
g	0.51	1.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.03
h	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
i	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
j	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
k	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25
l	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
n	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
q	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
r	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
s	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
y	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
z	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1.39	2.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.80

Appendix 6:Ae. Continued.

Percentage of grand total. Age= 8

	1	2	3	4	5	6	7	8	9	
a	0.13	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38
b	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.25
f	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
g	0.63	0.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.52
h	0.00	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.51
i	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
j	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.13
k	0.00	0.76	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.89
l	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
n	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
q	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
r	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
s	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
y	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
z	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.89	2.15	0.63	0.13	0.00	0.00	0.00	0.00	0.00	3.80

Percentage of grand total. Age= 9

	1	2	3	4	5	6	7	8	9	
a	0.51	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.76
b	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
f	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.25
g	0.38	0.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.27
h	0.00	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.51
i	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
j	0.00	0.00	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.38
k	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
l	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
m	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25
n	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
q	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
r	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
s	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
y	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
z	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1.01	1.90	0.89	0.00	0.00	0.00	0.00	0.00	0.00	3.80

Appendix 6:Ae. Continued.

Percentage of grand total. Age= 10

	1	2	3	4	5	6	7	8	9	
a	0.38	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.63
b	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e	0.00	0.13	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.25
f	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
g	0.13	0.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.63
h	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25
i	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
j	0.00	0.13	0.76	0.00	0.00	0.00	0.00	0.00	0.00	0.89
k	0.25	0.25	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.63
l	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
m	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
n	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
q	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
r	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
s	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
y	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
z	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.76	2.03	0.89	0.13	0.00	0.00	0.00	0.00	0.00	3.80

Percentage of grand total. Age= 11

	1	2	3	4	5	6	7	8	9	
a	0.51	0.13	0.13	0.63	0.00	0.00	0.00	0.00	0.00	1.39
b	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.25
e	0.00	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.51
f	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.13
g	0.38	0.25	0.13	0.13	0.00	0.00	0.00	0.00	0.00	0.89
h	0.00	0.51	1.01	0.25	0.00	0.00	0.00	0.00	0.00	1.77
i	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
j	0.00	0.25	1.01	0.13	0.00	0.00	0.00	0.00	0.00	1.39
k	0.25	2.03	0.13	9.38	0.00	0.00	0.00	0.00	0.00	11.79
l	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25
m	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
n	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
q	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
r	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
s	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
y	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
z	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
	1.14	3.93	2.79	10.77	0.00	0.00	0.00	0.00	0.00	18.63

Appendix 6:Ae. Continued.

Percentage of grand total. Age= 12

	1	2	3	4	5	6	7	8	9	
a	0.13	0.38	0.25	0.38	0.00	0.00	0.00	0.00	0.00	1.14
b	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.00	0.51	0.13	1.39	0.00	0.00	0.00	0.00	0.00	2.03
e	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.25
f	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
g	0.13	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.25
h	0.00	0.25	1.90	0.63	0.00	0.00	0.00	0.00	0.00	2.79
i	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
j	0.00	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.51
k	0.25	2.41	0.63	12.04	0.00	0.00	0.00	0.00	0.00	15.34
l	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
n	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
q	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
r	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
s	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
y	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.13
z	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.51	3.93	3.55	14.58	0.00	0.00	0.00	0.00	0.00	22.56

Percentage of grand total. Age= 13

	1	2	3	4	5	6	7	8	9	
a	0.00	0.13	0.00	0.51	0.00	0.00	0.00	0.00	0.00	0.63
b	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.25
e	0.00	0.13	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.51
f	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
g	0.00	0.13	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.25
h	0.00	0.00	1.52	0.13	0.00	0.00	0.00	0.00	0.00	1.65
i	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
j	0.00	0.00	1.65	0.00	0.00	0.00	0.00	0.00	0.00	1.65
k	0.13	1.52	1.14	13.05	0.00	0.00	0.00	0.00	0.00	15.84
l	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
n	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
q	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
r	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
s	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
y	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
z	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.13	1.90	4.69	14.07	0.00	0.00	0.00	0.00	0.00	20.79

Appendix 6:Ae. Continued.

Percentage of grand total. Age= 14

	1	2	3	4	5	6	7	8	9	
a	0.00	0.13	0.13	0.38	0.00	0.00	0.00	0.00	0.00	0.63
b	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
f	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
g	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
h	0.00	0.00	1.01	0.13	0.00	0.00	0.00	0.00	0.00	1.14
i	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
j	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.13
k	0.00	0.51	0.25	8.62	0.00	0.00	0.00	0.00	0.00	9.38
l	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
n	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
q	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
r	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
s	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
y	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
z	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.76	1.52	9.13	0.00	0.00	0.00	0.00	0.00	11.41

Appendix 6: B.

Data for tables drawn from imagination.

This appendix presents the data discussed in Chapter 4, classified according to the method given in Table 1. The total subject numbers, average age, standard deviation of age and percentage of the total response, summed over age, are given for each cell. The percentage response for each age group, is then given.

Appendix 6:Ba. Subject totals for tables drawn from imagination.
Appendix 6:Bb. Average ages for tables drawn from imagination.

SUBJECT TOTALS

	1	2	3	4	5	6	7	8	9	Total
a	525	175	11	26	29	13	1	23	0	803
b	14	22	3	0	6	8	0	0	2	55
c	0	0	3	0	0	0	0	0	0	3
d	1	0	0	0	0	0	0	0	0	1
e	1	40	223	1	1	0	0	0	0	266
f	0	4	33	0	0	0	0	0	0	37
g	300	283	9	14	37	57	4	29	3	736
h	0	15	570	4	5	2	15	0	0	611
i	0	3	0	0	0	0	0	0	0	3
j	1	31	291	2	1	0	0	0	0	326
k	82	191	14	177	7	23	2	5	0	501
l	0	135	0	1	2	6	0	0	0	144
m	0	17	13	1	1	0	0	0	0	32
n	33	43	0	0	20	5	0	4	0	105
o	0	38	1	0	30	2	1	0	1	73
p	0	9	0	0	1	0	0	0	0	10
q	1	19	4	0	0	0	0	0	0	24
r	0	7	0	0	36	1	0	0	0	44
s	2	0	2	0	15	15	0	0	0	34
t	0	2	0	0	0	0	0	0	0	2
u	0	0	0	0	0	1	0	1	0	2
v	0	94	0	0	7	1	0	0	0	102
w	0	0	0	0	0	0	0	0	0	0
x	0	26	0	0	19	0	0	0	0	45
y	0	15	0	0	4	0	0	0	0	19
z	7	10	1	0	4	10	0	0	0	32
tot	967	1179	1178	226	225	144	23	62	6	4010

AVERAGE AGES

	1	2	3	4	5	6	7	8	9	
a	7.45	7.72	12.18	11.92	5.52	7.77	7.00	6.61	0.00	7.63
b	7.64	6.18	11.00	0.00	4.50	11.38	0.00	0.00	6.00	7.38
c	0.00	0.00	8.33	0.00	0.00	0.00	0.00	0.00	0.00	8.33
d	14.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.00
e	7.00	10.45	12.28	10.00	8.00	0.00	0.00	0.00	0.00	11.96
f	0.00	9.75	10.94	0.00	0.00	0.00	0.00	0.00	0.00	10.81
g	7.49	7.20	10.56	11.57	6.43	7.67	7.50	6.97	6.33	7.43
h	0.00	10.20	13.73	12.00	9.60	9.00	9.13	0.00	0.00	13.47
i	0.00	6.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.67
j	12.00	10.84	12.15	11.00	9.00	0.00	0.00	0.00	0.00	12.01
k	9.59	10.07	11.50	12.41	10.29	10.87	9.50	7.20	0.00	10.86
l	0.00	9.31	0.00	11.00	8.00	8.83	0.00	0.00	0.00	9.28
m	0.00	8.65	11.46	11.00	12.00	0.00	0.00	0.00	0.00	9.97
n	5.33	5.35	0.00	0.00	4.40	7.20	0.00	6.00	0.00	5.28
o	0.00	8.11	10.00	0.00	3.70	5.00	8.00	0.00	4.00	6.18
p	0.00	6.22	0.00	0.00	7.00	0.00	0.00	0.00	0.00	6.30
q	8.00	10.53	9.50	0.00	0.00	0.00	0.00	0.00	0.00	10.25
r	0.00	4.43	0.00	0.00	4.72	3.00	0.00	0.00	0.00	4.64
s	13.00	0.00	17.50	0.00	6.60	11.20	0.00	0.00	0.00	9.65
t	0.00	6.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.50
u	0.00	0.00	0.00	0.00	0.00	14.00	0.00	7.00	0.00	10.50
v	0.00	7.03	0.00	0.00	6.43	9.00	0.00	0.00	0.00	7.01
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	7.88	0.00	0.00	5.84	0.00	0.00	0.00	0.00	7.02
y	0.00	7.20	0.00	0.00	5.75	0.00	0.00	0.00	0.00	6.89
z	10.00	10.10	11.00	0.00	9.75	15.70	0.00	0.00	0.00	11.81
	7.61	8.25	12.86	12.26	5.70	9.35	8.74	6.79	5.83	

Appendix 6:Bc. Standard deviations of age for tables drawn from imagination.
Appendix 6:Bd. Percentage of total response, summed over age, for tables drawn from imagination.

Percentage of grand total, summed over age

	1	2	3	4	5	6	7	8	9	
a	13.09	4.36	0.27	0.65	0.72	0.32	0.02	0.57	0.00	20.02
b	0.35	0.55	0.07	0.00	0.15	0.20	0.00	0.00	0.05	1.37
c	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.07
d	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
e	0.02	1.00	5.56	0.02	0.02	0.00	0.00	0.00	0.00	6.63
f	0.00	0.10	0.82	0.00	0.00	0.00	0.00	0.00	0.00	0.92
g	7.48	7.06	0.22	0.35	0.92	1.42	0.10	0.72	0.07	18.35
h	0.00	0.37	14.21	0.10	0.12	0.05	0.37	0.00	0.00	15.24
i	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07
j	0.02	0.77	7.26	0.05	0.02	0.00	0.00	0.00	0.00	8.13
k	2.04	4.76	0.35	4.41	0.17	0.57	0.05	0.12	0.00	12.49
l	0.00	3.37	0.00	0.02	0.05	0.15	0.00	0.00	0.00	3.59
m	0.00	0.42	0.32	0.02	0.02	0.00	0.00	0.00	0.00	0.80
n	0.82	1.07	0.00	0.00	0.50	0.12	0.00	0.10	0.00	2.62
o	0.00	0.95	0.02	0.00	0.75	0.05	0.02	0.00	0.02	1.82
p	0.00	0.22	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.25
q	0.02	0.47	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.60
r	0.00	0.17	0.00	0.00	0.90	0.02	0.00	0.00	0.00	1.10
s	0.05	0.00	0.05	0.00	0.37	0.37	0.00	0.00	0.00	0.85
t	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
u	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.02	0.00	0.05
v	0.00	2.34	0.00	0.00	0.17	0.02	0.00	0.00	0.00	2.54
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.65	0.00	0.00	0.47	0.00	0.00	0.00	0.00	1.12
y	0.00	0.37	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.47
z	0.17	0.25	0.02	0.00	0.10	0.25	0.00	0.00	0.00	0.80
	24.11	29.40	29.38	5.64	5.61	3.59	0.57	1.55	0.15	x100.00

STANDARD DEVIATIONS OF AGES

	1	2	3	4	5	6	7	8	9	
a	2.73	2.36	2.23	1.98	2.54	3.09	0.00	2.29	0.00	2.81
b	2.65	1.65	1.00	0.00	0.84	7.35	0.00	0.00	1.41	3.82
c	0.00	0.00	2.31	0.00	0.00	0.00	0.00	0.00	0.00	2.31
d	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e	0.00	1.66	5.15	0.00	0.00	0.00	0.00	0.00	0.00	4.82
f	0.00	0.96	2.38	0.00	0.00	0.00	0.00	0.00	0.00	2.30
g	1.95	1.85	2.07	7.18	1.92	1.71	1.00	1.55	1.53	2.21
h	0.00	2.27	6.02	1.15	1.52	1.41	1.60	0.00	0.00	5.92
i	0.00	0.58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.58
j	0.00	1.98	5.02	0.00	0.00	0.00	0.00	0.00	0.00	4.80
k	1.97	2.78	1.70	3.03	1.70	3.35	0.71	1.48	0.00	2.99
l	0.00	1.66	0.00	0.00	1.41	1.60	0.00	0.00	0.00	1.65
m	0.00	2.89	1.51	0.00	0.00	0.00	0.00	0.00	0.00	2.69
n	1.67	1.07	0.00	0.00	1.50	3.49	0.00	0.82	0.00	1.60
o	0.00	4.40	0.00	0.00	1.90	1.41	0.00	0.00	0.00	4.04
p	0.00	1.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.16
q	0.00	1.68	2.03	0.00	0.00	0.00	0.00	0.00	0.00	1.78
r	0.00	0.53	0.00	0.00	1.16	0.00	0.00	0.00	0.00	1.10
s	1.41	0.00	6.36	0.00	3.16	4.57	0.00	0.00	0.00	4.91
t	0.00	2.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.12
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.95
v	0.00	1.90	0.00	0.00	2.57	0.00	0.00	0.00	0.00	2.03
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	1.53	0.00	0.00	1.21	0.00	0.00	0.00	0.00	1.73
y	0.00	1.37	0.00	0.00	1.50	0.00	0.00	0.00	0.00	1.49
z	1.53	2.02	0.00	0.00	1.26	10.07	0.00	0.00	0.00	6.19
	2.54	2.63	5.48	3.27	2.45	4.61	1.54	1.80	1.47	

Appendix 6:Be. Percentage response for each age group for tables drawn from imagination.

Percentage of grand total. Age= 4

	1	2	3	4	5	6	7	8	9	
a	1.15	0.35	0.00	0.00	0.20	0.00	0.00	0.00	0.00	1.70
b	0.02	0.07	0.00	0.00	0.10	0.02	0.00	0.00	0.00	0.22
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
f	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
g	0.27	0.20	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.60
h	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
i	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
j	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
k	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
l	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
n	0.22	0.22	0.00	0.00	0.10	0.02	0.00	0.00	0.00	0.57
o	0.00	0.10	0.00	0.00	0.20	0.02	0.00	0.00	0.02	0.35
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
q	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
r	0.00	0.10	0.00	0.00	0.27	0.00	0.00	0.00	0.00	0.37
s	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	0.07	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.15
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.10
y	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.02
z	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1.67	1.15	0.00	0.00	1.20	0.07	0.00	0.00	0.02	4.11

Percentage of grand total. Age= 3 or less

	1	2	3	4	5	6	7	8	9	
a	0.05	0.00	0.00	0.00	0.10	0.02	0.00	0.00	0.00	0.17
b	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
f	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
g	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.02
h	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
i	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
j	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
k	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
l	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
n	0.05	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.20
o	0.00	0.02	0.00	0.00	0.45	0.00	0.00	0.00	0.00	0.47
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
q	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
r	0.00	0.00	0.00	0.00	0.10	0.02	0.00	0.00	0.00	0.12
s	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.07
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
y	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
z	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.10	0.07	0.00	0.00	0.90	0.05	0.00	0.00	0.00	1.12

Appendix 6:Be. Continued.

Percentage of grand total. Age= 5

	1	2	3	4	5	6	7	8	9	
a	1.82	0.50	0.00	0.00	0.20	0.02	0.00	0.20	0.00	2.74
b	0.05	0.17	0.00	0.00	0.02	0.00	0.00	0.00	0.02	0.27
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
f	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02
g	0.72	1.00	0.00	0.00	0.17	0.07	0.00	0.10	0.02	2.09
h	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.02
i	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
j	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
k	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.12
l	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
m	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
n	0.32	0.45	0.00	0.00	0.20	0.05	0.00	0.02	0.00	1.05
o	0.00	0.12	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.15
p	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10
q	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
r	0.00	0.07	0.00	0.00	0.35	0.00	0.00	0.00	0.00	0.42
s	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.12
t	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	0.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.45
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.02	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.07
y	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.02
z	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2.92	3.09	0.02	0.00	1.17	0.15	0.02	0.35	0.05	7.78

Percentage of grand total. Age= 6

	1	2	3	4	5	6	7	8	9	
a	2.42	0.62	0.00	0.00	0.07	0.10	0.00	0.20	0.00	3.42
b	0.07	0.10	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.20
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.00	0 00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e	0.00	0.05	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.07
f	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
g	1.45	1.70	0.00	0.00	0.17	0.35	0.00	0.22	0.02	3.92
h	0.00	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.05
i	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
j	0.00	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.05
k	0.15	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.32
l	0.00	0.05	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.07
m	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10
n	0.02	0.25	0.00	0.00	0.02	0.00	0.00	0.05	0.00	0.35
o	0.00	0.05	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.07
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
q	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
r	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.12
s	0.00	0.00	0.00	0.00	0.02	0.02	0.00	0.00	0.00	0.05
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	0.52	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.55
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.05	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.22
y	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12
z	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4.11	3.87	0.07	0.00	0.65	0.52	0.00	0.47	0.02	9.73

6 25

Appendix 6:Be. Continued.

Percentage of grand total. Age= 7

	1	2	3	4	5	6	7	8	9	
a	2.57	0.62	0.00	0.00	0.00	0.02	0.02	0.07	0.00	3.32
b	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.07
c	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.05
d	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e	0.02	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.07
f	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
g	1.97	1.67	0.02	0.02	0.17	0.25	0.07	0.20	0.00	4.39
h	0.00	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.10
i	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
j	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.07
k	0.17	0.27	0.00	0.02	0.02	0.02	0.00	0.05	0.00	0.57
l	0.00	0.40	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.42
m	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
n	0.10	0.10	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.22
o	0.00	0.12	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.15
p	0.00	0.10	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.12
q	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02
r	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.02
s	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.02
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.02
v	0.00	0.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.52
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.07	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.20
y	0.00	0.15	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.20
z	0.02	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07
	4.89	4.24	0.27	0.05	0.47	0.32	0.10	0.37	0.02	10.75

Percentage of grand total. Age= 8

	1	2	3	4	5	6	7	8	9	
a	1.60	0.82	0.00	0.02	0.05	0.02	0.00	0.02	0.00	2.54
b	0.07	0.12	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.27
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e	0.00	0.02	0.10	0.00	0.02	0.00	0.00	0.00	0.00	0.15
f	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02
g	0.90	0.75	0.00	0.05	0.10	0.37	0.00	0.10	0.02	2.29
h	0.00	0.00	0.12	0.00	0.05	0.02	0.07	0.00	0.00	0.27
i	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
j	0.00	0.07	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.30
k	0.27	0.42	0.00	0.05	0.00	0.05	0.00	0.02	0.00	0.82
l	0.00	0.45	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.47
m	0.00	0.05	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.07
n	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10
o	0.00	0.22	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.25
p	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
q	0.02	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07
r	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.02
s	0.00	0.00	0.00	0.00	0.02	0.05	0.00	0.00	0.00	0.07
t	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	0.25	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.27
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.20	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.22
y	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
z	0.00	0.00	0.00	0.00	0.02	0.02	0.00	0.00	0.00	0.05
	2.92	3.59	0.50	0.12	0.35	0.65	0.10	0.15	0.02	8.40

Appendix 6:Be. Continued.

6-27

Percentage of grand total.   Age= 9

	1	2	3	4	5	6	7	8	9	
a	1.05	0.47	0.05	0.10	0.02	0.05	0.00	0.02	0.00	1.77
b	0.02	0.05	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.10
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e	0.00	0.20	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.52
f	0.00	0.05	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.27
g	1.02	0.82	0.05	0.07	0.12	0.25	0.02	0.02	0.00	2.39
h	0.00	0.02	0.52	0.00	0.00	0.00	0.12	0.00	0.00	0.67
i	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
j	0.00	0.07	0.62	0.00	0.02	0.00	0.00	0.00	0.00	0.72
k	0.35	0.90	0.05	0.40	0.02	0.15	0.02	0.02	0.00	1.92
l	0.00	1.10	0.00	0.00	0.02	0.02	0.00	0.00	0.00	1.15
m	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
n	0.02	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.05
o	0.00	0.10	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.12
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
q	0.00	0.10	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.12
r	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
s	0.00	0.00	0.00	0.00	0.02	0.05	0.00	0.00	0.00	0.07
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	0.20	0.00	0.00	0.02	0.02	0.00	0.00	0.00	0.25
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25
y	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
z	0.02	0.02	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.07
	2.49	4.44	1.87	0.57	0.32	0.60	0.17	0.07	0.00	10.55

Percentage of grand total.   Age= 10

	1	2	3	4	5	6	7	8	9	
a	0.75	0.40	0.00	0.00	0.02	0.02	0.00	0.00	0.00	1.20
b	0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.05
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e	0.00	0.15	1.27	0.02	0.00	0.00	0.00	0.00	0.00	1.45
f	0.00	0.02	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.15
g	0.57	0.60	0.02	0.05	0.00	0.00	0.00	0.05	0.00	1.30
h	0.00	0.07	1.80	0.00	0.02	0.02	0.10	0.00	0.00	2.02
i	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
j	0.00	0.15	1.25	0.00	0.00	0.00	0.00	0.00	0.00	1.40
k	0.52	0.92	0.05	0.42	0.00	0.07	0.02	0.00	0.00	2.02
l	0.00	0.67	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.75
m	0.00	0.02	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.07
n	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
o	0.00	0.05	0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.10
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
q	0.00	0.12	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.15
r	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
s	0.00	0.00	0.00	0.00	0.05	0.02	0.00	0.00	0.00	0.07
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	0.10	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.12
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
y	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
z	0.02	0.07	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.15
	1.92	3.39	4.64	0.50	0.20	0.22	0.12	0.05	0.00	11.05

Appendix 6:Be. Continued.

Percentage of grand total. Age= 11

	1	2	3	4	5	6	7	8	9	
a	0.60	0.25	0.05	0.15	0.00	0.02	0.00	0.00	0.00	1.07
b	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02
c	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02
d	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e	0.00	0.35	1.12	0.00	0.00	0.00	0.00	0.00	0.00	1.47
f	0.00	0.02	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.12
g	0.25	0.20	0.05	0.10	0.00	0.07	0.00	0.02	0.00	0.70
h	0.00	0.12	2.59	0.05	0.05	0.00	0.02	0.00	0.00	2.84
i	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
j	0.00	0.17	1.90	0.05	0.00	0.00	0.00	0.00	0.00	2.12
k	0.15	1.05	0.10	0.62	0.10	0.17	0.00	0.00	0.00	2.19
l	0.00	0.37	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.40
m	0.00	0.02	0.07	0.02	0.00	0.00	0.00	0.00	0.00	0.12
n	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.05
o	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
q	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
r	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
s	0.00	0.00	0.00	0.00	0.02	0.05	0.00	0.00	0.00	0.07
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
y	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
z	0.10	0.02	0.02	0.00	0.02	0.05	0.00	0.00	0.00	0.22
	1.10	2.82	6.06	1.02	0.20	0.42	0.02	0.02	0.00	11.67

Percentage of grand total. Age= 12

	1	2	3	4	5	6	7	8	9	
a	0.30	0.17	0.07	0.10	0.05	0.00	0.00	0.02	0.00	0.72
b	0.02	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.00	0.07
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e	0.00	0.15	0.97	0.00	0.00	0.00	0.00	0.00	0.00	1.12
f	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.12
g	0.25	0.05	0.05	0.02	0.02	0.02	0.00	0.00	0.00	0.42
h	0.00	0.05	2.49	0.00	0.00	0.00	0.02	0.00	0.00	2.57
i	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
j	0.02	0.10	1.32	0.00	0.00	0.00	0.00	0.00	0.00	1.45
k	0.30	0.40	0.02	0.85	0.02	0.02	0.00	0.00	0.00	1.62
l	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15
m	0.00	0.02	0.07	0.00	0.02	0.00	0.00	0.00	0.00	0.12
n	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
o	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
q	0.00	0.10	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.12
r	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
s	0.02	0.00	0.00	0.00	0.02	0.10	0.00	0.00	0.00	0.15
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
y	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
z	0.00	0.05	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.07
	0.92	1.37	5.19	0.97	0.15	0.20	0.02	0.02	0.00	8.85

Appendix 6:Be. Continued.

Percentage of grand total. Age= 13

	1	2	3	4	5	6	7	8	9	
a	0.42	0.10	0.02	0.07	0.00	0.00	0.00	0.00	0.00	0.62
b	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e	0.00	0.05	0.57	0.00	0.00	0.00	0.00	0.00	0.00	0.62
f	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.07
g	0.05	0.05	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.12
h	0.00	0.00	2.19	0.05	0.00	0.00	0.00	0.00	0.00	2.24
i	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
j	0.00	0.12	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.92
k	0.07	0.35	0.07	0.90	0.00	0.02	0.00	0.00	0.00	1.42
l	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10
m	0.00	0.07	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.17
n	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
o	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
q	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07
r	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
s	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
y	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
z	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
	0.57	0.97	3.87	1.02	0.00	0.05	0.00	0.00	0.00	6.48

Percentage of grand total. Age= 14

	1	2	3	4	5	6	7	8	9	
a	0.25	0.02	0.02	0.17	0.00	0.00	0.00	0.02	0.00	0.50
b	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.02
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
e	0.00	0.02	0.67	0.00	0.00	0.00	0.00	0.00	0.00	0.70
f	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.07
g	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.07
h	0.00	0.00	1.95	0.00	0.00	0.00	0.00	0.00	0.00	1.95
i	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
j	0.00	0.02	0.45	0.00	0.00	0.00	0.00	0.00	0.00	0.47
k	0.05	0.10	0.05	0.82	0.00	0.00	0.00	0.00	0.00	1.02
l	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
n	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
q	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
r	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
s	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.02
v	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
y	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
z	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.02
	0.37	0.22	3.24	1.00	0.00	0.07	0.00	0.02	0.00	4.94

Appendix 6:Be. Continued.

Percentage of grand total. Age= 15

	1	2	3	4	5	6	7	8	9	
a	0.07	0.02	0.02	0.02	0.00	0.02	0.00	0.00	0.00	0.17
b	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.15
f	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02
g	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
h	0.00	0.02	0.55	0.00	0.00	0.00	0.00	0.00	0.00	0.57
i	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
j	0.00	0.02	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.25
k	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.20
l	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
n	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
q	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
r	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
s	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
y	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
z	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.07	0.10	0.97	0.22	0.00	0.02	0.00	0.00	0.00	1.40

Percentage of grand total. Age= 16

	1	2	3	4	5	6	7	8	9	
a	0.05	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.07
b	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.02
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e	0.00	0.00	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.30
f	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02
g	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.02
h	0.00	0.00	1.92	0.00	0.00	0.00	0.00	0.00	0.00	1.92
i	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
j	0.00	0.00	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.37
k	0.00	0.05	0.00	0.12	0.00	0.05	0.00	0.00	0.00	0.22
l	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
n	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
o	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
q	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
r	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
s	0.00	0.00	0.02	0.00	0.00	0.05	0.00	0.00	0.00	0.07
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
y	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
z	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.10
	0.05	0.07	2.67	0.15	0.00	0.22	0.00	0.00	0.00	3.17

Appendix 6: C.

Amalgamated data for tables drawn from observation and imagination.

This appendix presents the data discussed in Chapters 3 and 4. These data have been amalgamated and classified according to the method given in Table 1. The total subject numbers, average age, standard deviation of age and percentage of the total response, summed over age, are given for each cell. The percentage response for each age group, is then given.

Appendix 6:Ca. Subject totals for tables drawn from observation and imagination.
Appendix 6:Cb. Average ages for tables drawn from observation and imagination.

SUBJECT TOTALS

	1	2	3	4	5	6	7	8	9	Total
a	577	204	15	41	29	13	1	23	0	903
b	16	27	3	0	6	8	0	0	2	62
c	0	0	3	0	0	0	0	0	0	3
d	1	4	1	15	0	0	0	0	0	21
e	1	45	233	1	1	0	0	0	0	281
f	0	5	36	0	0	0	0	0	0	41
g	327	336	11	16	37	57	4	29	3	820
h	0	28	617	13	5	2	15	0	0	680
i	0	4	0	0	0	0	0	0	0	4
j	1	36	326	3	1	0	0	0	0	367
k	90	253	31	519	7	23	2	5	0	930
l	0	137	0	1	2	6	0	0	0	146
m	0	21	13	1	1	0	0	0	0	36
n	33	43	0	0	20	5	0	4	0	105
o	0	40	1	0	30	2	1	0	1	75
p	0	9	0	0	1	0	0	0	0	10
q	1	19	4	0	0	0	0	0	0	24
r	0	7	0	0	36	1	0	0	0	44
s	2	0	2	0	15	15	0	0	0	34
t	0	2	0	0	0	0	0	0	0	2
u	0	0	0	0	0	1	0	1	0	2
v	0	103	0	0	7	1	0	0	0	111
w	0	0	0	0	0	0	0	0	0	0
x	0	26	0	0	19	0	0	0	0	45
y	0	15	0	1	4	0	0	0	0	20
z	7	11	1	0	4	10	0	0	0	33
tot	1056	1375	1297	611	225	144	23	62	6	4799

AVERAGE AGES

	1	2	3	4	5	6	7	8	9	
a	7.36	7.69	12.20	12.07	5.52	7.77	7.00	6.61	0.00	7.66
b	7.50	6.15	11.00	0.00	4.50	11.38	0.00	0.00	6.00	7.24
c	0.00	0.00	8.33	0.00	0.00	0.00	0.00	0.00	0.00	8.33
d	14.00	12.00	12.00	12.00	0.00	0.00	0.00	0.00	0.00	12.10
e	7.00	10.49	12.23	10.00	8.00	0.00	0.00	0.00	0.00	11.91
f	0.00	9.00	10.83	0.00	0.00	0.00	0.00	0.00	0.00	10.61
g	7.50	7.21	10.73	11.63	6.43	7.67	7.50	6.97	6.33	7.45
h	0.00	10.07	13.61	12.08	9.60	9.00	9.13	0.00	0.00	13.29
i	0.00	6.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.50
j	12.00	10.89	12.06	11.00	9.00	0.00	0.00	0.00	0.00	11.93
k	9.71	10.38	12.16	12.45	10.29	10.87	9.50	7.20	0.00	11.52
l	0.00	9.34	0.00	11.00	8.00	8.83	0.00	0.00	0.00	9.31
m	0.00	8.86	11.46	11.00	12.00	0.00	0.00	0.00	0.00	9.94
n	5.33	5.35	0.00	0.00	4.40	7.20	0.00	6.00	0.00	5.28
o	0.00	7.93	10.00	0.00	3.70	5.00	8.00	0.00	4.00	6.13
p	0.00	6.22	0.00	0.00	7.00	0.00	0.00	0.00	0.00	6.30
q	8.00	10.53	9.50	0.00	0.00	0.00	0.00	0.00	0.00	10.25
r	0.00	4.43	0.00	0.00	4.72	3.00	0.00	0.00	0.00	4.64
s	13.00	0.00	17.50	0.00	6.60	11.20	0.00	0.00	0.00	9.65
t	0.00	6.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.50
u	0.00	0.00	0.00	0.00	0.00	14.00	0.00	7.00	0.00	10.50
v	0.00	7.04	0.00	0.00	6.43	9.00	0.00	0.00	0.00	7.02
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	7.88	0.00	0.00	5.84	0.00	0.00	0.00	0.00	7.02
y	0.00	7.20	0.00	12.00	5.75	0.00	0.00	0.00	0.00	7.15
z	10.00	10.18	11.00	0.00	9.75	15.70	0.00	0.00	0.00	11.79
	7.58	8.37	12.77	12.36	5.70	9.35	8.74	6.79	5.83	

Appendix 6:Cc. Standard deviations of age for tables drawn from observation and imagination.

Appendix 6:Cd. Percentage of total response, summed over age, for tables drawn from observation and imagination.

Percentage of grand total, summed over age

	1	2	3	4	5	6	7	8	9	
a	12.02	4.25	0.31	0.85	0.60	0.27	0.02	0.48	0.00	18.82
b	0.33	0.56	0.06	0.00	0.13	0.17	0.00	0.00	0.04	1.29
c	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.06
d	0.02	0.08	0.02	0.31	0.00	0.00	0.00	0.00	0.00	0.44
e	0.02	0.94	4.86	0.02	0.02	0.00	0.00	0.00	0.00	5.86
f	0.00	0.10	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.85
g	6.81	7.00	0.23	0.33	0.77	1.19	0.08	0.60	0.06	17.09
h	0.00	0.58	12.86	0.27	0.10	0.04	0.31	0.00	0.00	14.17
i	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08
j	0.02	0.75	6.79	0.06	0.02	0.00	0.00	0.00	0.00	7.65
k	1.88	5.27	0.65	10.81	0.15	0.48	0.04	0.10	0.00	19.38
l	0.00	2.85	0.00	0.02	0.04	0.13	0.00	0.00	0.00	3.04
m	0.00	0.44	0.27	0.02	0.02	0.00	0.00	0.00	0.00	0.75
n	0.69	0.90	0.00	0.00	0.42	0.10	0.00	0.08	0.00	2.19
o	0.00	0.83	0.02	0.00	0.63	0.04	0.02	0.00	0.02	1.56
p	0.00	0.19	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.21
q	0.02	0.40	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.50
r	0.00	0.15	0.00	0.00	0.75	0.02	0.00	0.00	0.00	0.92
s	0.04	0.00	0.04	0.00	0.31	0.31	0.00	0.00	0.00	0.71
t	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
u	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.02	0.00	0.04
v	0.00	2.15	0.00	0.00	0.15	0.02	0.00	0.00	0.00	2.31
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.54	0.00	0.00	0.40	0.00	0.00	0.00	0.00	0.94
y	0.00	0.31	0.00	0.02	0.08	0.00	0.00	0.00	0.00	0.42
z	0.15	0.23	0.02	0.00	0.08	0.21	0.00	0.00	0.00	0.69
	22.00	28.65	27.03	12.73	4.69	3.00	0.48	1.29	0.13	%100.00

STANDARD DEVIATIONS OF AGES

	1	2	3	4	5	6	7	8	9	
a	2.70	2.49	1.97	1.72	2.54	3.09	0.00	2.29	0.00	2.86
b	2.56	1.99	1.00	0.00	0.84	7.35	0.00	0.00	1.41	3.73
c	0.00	0.00	2.31	0.00	0.00	0.00	0.00	0.00	0.00	2.31
d	0.00	0.00	0.00	0.53	0.00	0.00	0.00	0.00	0.00	0.62
e	0.00	1.63	5.05	0.00	0.00	0.00	0.00	0.00	0.00	4.71
f	0.00	1.87	2.32	0.00	0.00	0.00	0.00	0.00	0.00	2.33
g	1.96	1.93	1.90	6.69	1.92	1.71	1.00	1.55	1.53	2.22
h	0.00	1.96	5.82	0.95	1.52	1.41	1.60	0.00	0.00	5.66
i	0.00	0.58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.58
j	0.00	1.86	4.79	0.00	0.00	0.00	0.00	0.00	0.00	4.56
k	1.96	2.65	1.39	1.97	1.70	3.35	0.71	1.48	0.00	2.47
l	0.00	1.66	0.00	0.00	1.41	1.60	0.00	0.00	0.00	1.65
m	0.00	2.65	1.51	0.00	0.00	0.00	0.00	0.00	0.00	2.55
n	1.67	1.07	0.00	0.00	1.50	3.49	0.00	0.82	0.00	1.60
o	0.00	4.36	0.00	0.00	1.90	1.41	0.00	0.00	0.00	3.99
p	0.00	1.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.16
q	0.00	1.68	2.08	0.00	0.00	0.00	0.00	0.00	0.00	1.78
r	0.00	0.53	0.00	0.00	1.16	0.00	0.00	0.00	0.00	1.10
s	1.41	0.00	6.36	0.00	3.16	4.57	0.00	0.00	0.00	4.91
t	0.00	2.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.12
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.95
v	0.00	2.05	0.00	0.00	2.57	0.00	0.00	0.00	0.00	2.06
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	1.53	0.00	0.00	1.21	0.00	0.00	0.00	0.00	1.73
y	0.00	1.37	0.00	0.00	1.50	0.00	0.00	0.00	0.00	1.84
z	1.53	1.94	0.00	0.00	1.26	10.07	0.00	0.00	0.00	6.10
	2.53	2.69	5.25	2.16	2.45	4.61	1.54	1.80	1.47	

Appendix 6:Ce. Percentage response for each age group for tables drawn from observation and imagination.

Percentage of grand total. Age= 3 & more

	1	2	3	4	5	6	7	8	9	
a	0.04	0.00	0.00	0.00	0.08	0.02	0.00	0.00	0.00	0.15
b	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
f	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
g	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.02
h	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
i	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
j	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
k	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
l	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
n	0.04	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.17
o	0.00	0.02	0.00	0.00	0.38	0.00	0.00	0.00	0.00	0.40
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
q	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
r	0.00	0.00	0.00	0.00	0.08	0.02	0.00	0.00	0.00	0.10
s	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.06
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
y	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
z	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.08	0.06	0.00	0.00	0.75	0.04	0.00	0.00	0.00	0.94

Percentage of grand total. Age= 4

	1	2	3	4	5	6	7	8	9	
a	1.17	0.42	0.00	0.00	0.17	0.00	0.00	0.00	0.00	1.75
b	0.02	0.10	0.00	0.00	0.08	0.02	0.00	0.00	0.00	0.23
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
f	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
g	0.25	0.31	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.67
h	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
i	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
j	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
k	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
l	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
n	0.19	0.19	0.00	0.00	0.08	0.02	0.00	0.00	0.00	0.48
o	0.00	0.10	0.00	0.00	0.17	0.02	0.00	0.00	0.02	0.31
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
q	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
r	0.00	0.08	0.00	0.00	0.23	0.00	0.00	0.00	0.00	0.31
s	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	0.13	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.19
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.08
y	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.02
z	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1.63	1.35	0.00	0.00	1.00	0.06	0.00	0.00	0.02	4.06

Appendix 6:Ce. Continued.

Percentage of grand total. Age= 5

	1	2	3	4	5	6	7	8	9	
a	1.77	0.50	0.00	0.00	0.17	0.02	0.00	0.17	0.00	2.63
b	0.06	0.19	0.00	0.00	0.02	0.00	0.00	0.00	0.02	0.29
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
f	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02
g	0.65	0.98	0.00	0.00	0.15	0.06	0.00	0.08	0.02	1.94
h	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.02
i	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
j	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
k	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.13
l	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
m	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
n	0.27	0.38	0.00	0.00	0.17	0.04	0.00	0.02	0.00	0.88
o	0.00	0.13	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.15
p	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08
q	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
r	0.00	0.06	0.00	0.00	0.29	0.00	0.00	0.00	0.00	0.35
s	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.10
t	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.02	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.06
y	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.02
z	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2.75	2.90	0.02	0.00	0.98	0.13	0.02	0.29	0.04	7.13

Percentage of grand total. Age= 6

	1	2	3	4	5	6	7	8	9	
a	2.23	0.60	0.00	0.00	0.06	0.08	0.00	0.17	0.00	3.15
b	0.06	0.08	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.17
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e	0.00	0.04	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.06
f	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
g	1.35	1.52	0.00	0.00	0.15	0.29	0.00	0.19	0.02	3.52
h	0.00	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.04
i	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
j	0.00	0.02	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.06
k	0.13	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27
l	0.00	0.04	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.06
m	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08
n	0.02	0.21	0.00	0.00	0.02	0.00	0.00	0.04	0.00	0.29
o	0.00	0.04	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.06
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
q	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
r	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.10
s	0.00	0.00	0.00	0.00	0.02	0.02	0.00	0.00	0.00	0.04
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	0.46	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.48
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.04	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.19
y	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10
z	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3.79	3.48	0.08	0.00	0.54	0.44	0.00	0.40	0.02	8.75

Appendix 6:Ce. Continued.

Percentage of grand total. Age= 7

	1	2	3	4	5	6	7	8	9	
a	2.29	0.58	0.00	0.00	0.00	0.02	0.02	0.06	0.00	2.98
b	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.06
c	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.04
d	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e	0.02	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.06
f	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
g	1.73	1.65	0.02	0.02	0.15	0.21	0.06	0.17	0.00	4.00
h	0.00	0.06	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.10
i	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
j	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.06
k	0.15	0.27	0.00	0.02	0.02	0.02	0.00	0.04	0.00	0.52
l	0.00	0.33	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.35
m	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
n	0.08	0.08	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.19
o	0.00	0.10	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.13
p	0.00	0.08	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.10
q	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02
r	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.02
s	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.02
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.02
v	0.00	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.46
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.06	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.17
y	0.00	0.13	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.17
z	0.02	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06
	4.31	3.94	0.23	0.04	0.40	0.27	0.08	0.31	0.02	9.61

Percentage of grand total. Age= 8

	1	2	3	4	5	6	7	8	9	
a	1.35	0.73	0.00	0.02	0.04	0.02	0.00	0.02	0.00	2.19
b	0.08	0.10	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.25
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e	0.00	0.02	0.13	0.00	0.02	0.00	0.00	0.00	0.00	0.17
f	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02
g	0.85	0.77	0.00	0.04	0.08	0.31	0.00	0.08	0.02	2.17
h	0.00	0.04	0.15	0.00	0.04	0.02	0.06	0.00	0.00	0.31
i	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
j	0.00	0.06	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.27
k	0.23	0.48	0.00	0.06	0.00	0.04	0.00	0.02	0.00	0.83
l	0.00	0.38	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.40
m	0.00	0.04	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.06
n	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08
o	0.00	0.19	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.21
p	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
q	0.02	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06
r	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.02
s	0.00	0.00	0.00	0.00	0.02	0.04	0.00	0.00	0.00	0.06
t	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	0.21	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.23
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.17	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.19
y	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
z	0.00	0.00	0.00	0.00	0.02	0.02	0.00	0.00	0.00	0.04
	2.58	3.35	0.52	0.13	0.29	0.54	0.08	0.13	0.02	7.65

6-37

Percentage of grand total.   Age= 9

	1	2	3	4	5	6	7	8	9	
a	0.96	0.44	0.04	0.08	0.02	0.04	0.00	0.02	0.00	1.60
b	0.02	0.04	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.08
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e	0.00	0.19	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.46
f	0.00	0.04	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.27
g	0.92	0.83	0.04	0.06	0.10	0.21	0.02	0.02	0.00	2.21
h	0.00	0.06	0.48	0.00	0.00	0.00	0.10	0.00	0.00	0.65
i	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
j	0.00	0.06	0.58	0.00	0.02	0.00	0.00	0.00	0.00	0.67
k	0.31	0.75	0.04	0.33	0.02	0.13	0.02	0.02	0.00	1.63
l	0.00	0.92	0.00	0.00	0.02	0.02	0.00	0.00	0.00	0.96
m	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08
n	0.02	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.04
o	0.00	0.08	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.10
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
q	0.00	0.08	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.10
r	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
s	0.00	0.00	0.00	0.00	0.02	0.04	0.00	0.00	0.00	0.06
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	0.19	0.00	0.00	0.02	0.02	0.00	0.00	0.00	0.23
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21
y	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
z	0.02	0.02	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.06
	2.25	4.02	1.71	0.48	0.27	0.50	0.15	0.06	0.00	9.44

Percentage of grand total.   Age= 10

	1	2	3	4	5	6	7	8	9	
a	0.69	0.38	0.00	0.00	0.02	0.02	0.00	0.00	0.00	1.10
b	0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.04
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e	0.00	0.15	1.08	0.02	0.00	0.00	0.00	0.00	0.00	1.25
f	0.00	0.02	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.13
g	0.50	0.58	0.02	0.04	0.00	0.00	0.00	0.04	0.00	1.19
h	0.00	0.10	1.50	0.00	0.02	0.02	0.08	0.00	0.00	1.73
i	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
j	0.00	0.15	1.17	0.00	0.00	0.00	0.00	0.00	0.00	1.31
k	0.48	0.81	0.04	0.38	0.00	0.06	0.02	0.00	0.00	1.79
l	0.00	0.56	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.63
m	0.00	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.08
n	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
o	0.00	0.04	0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.08
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
q	0.00	0.10	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.13
r	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
s	0.00	0.00	0.00	0.00	0.04	0.02	0.00	0.00	0.00	0.06
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	0.15	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.17
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
y	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
z	0.02	0.06	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.13
	1.73	3.17	4.02	0.44	0.17	0.19	0.10	0.04	0.00	9.86

Appendix 6:Ce. Continued.

Appendix 6:Ce. Continued.

Percentage of grand total. Age= 11

	1	2	3	4	5	6	7	8	9	
a	0.58	0.23	0.06	0.23	0.00	0.02	0.00	0.00	0.00	1.13
b	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02
c	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02
d	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.04
e	0.00	0.33	0.98	0.00	0.00	0.00	0.00	0.00	0.00	1.31
f	0.00	0.02	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.13
g	0.27	0.21	0.06	0.10	0.00	0.06	0.00	0.02	0.00	0.73
h	0.00	0.19	2.33	0.08	0.04	0.00	0.02	0.00	0.00	2.67
i	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
j	0.00	0.19	1.75	0.06	0.00	0.00	0.00	0.00	0.00	2.00
k	0.17	1.21	0.10	2.06	0.08	0.15	0.00	0.00	0.00	3.77
l	0.00	0.35	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.38
m	0.00	0.04	0.06	0.02	0.00	0.00	0.00	0.00	0.00	0.13
n	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.04
o	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
q	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
r	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
s	0.00	0.00	0.00	0.00	0.02	0.04	0.00	0.00	0.00	0.06
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
y	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
z	0.08	0.04	0.02	0.00	0.02	0.04	0.00	0.00	0.00	0.21
	1.10	3.00	5.52	2.63	0.17	0.35	0.02	0.02	0.00	12.82

Percentage of grand total. Age= 12

	1	2	3	4	5	6	7	8	9	
a	0.27	0.21	0.10	0.15	0.04	0.00	0.00	0.02	0.00	0.79
b	0.02	0.02	0.02	0.00	0.00	0.02	0.00	0.00	0.00	0.08
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.00	0.08	0.02	0.23	0.00	0.00	0.00	0.00	0.00	0.33
e	0.00	0.13	0.85	0.00	0.00	0.00	0.00	0.00	0.00	0.98
f	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.10
g	0.23	0.04	0.06	0.02	0.02	0.02	0.00	0.00	0.00	0.40
h	0.00	0.08	2.40	0.10	0.00	0.00	0.02	0.00	0.00	2.60
i	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
j	0.02	0.13	1.15	0.00	0.00	0.00	0.00	0.00	0.00	1.29
k	0.29	0.73	0.13	2.69	0.02	0.02	0.00	0.00	0.00	3.88
l	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
m	0.00	0.02	0.06	0.00	0.02	0.00	0.00	0.00	0.00	0.10
n	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
o	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
q	0.00	0.08	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.10
r	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
s	0.02	0.00	0.00	0.00	0.02	0.08	0.00	0.00	0.00	0.13
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
y	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.02
z	0.00	0.04	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.06
	0.85	1.79	4.92	3.21	0.13	0.17	0.02	0.02	0.00	11.11

Appendix 6:Ce. Continued.

Percentage of grand total. Age= 13

	1	2	3	4	5	6	7	8	9	
a	0.35	0.10	0.02	0.15	0.00	0.00	0.00	0.00	0.00	0.63
b	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.04
e	0.00	0.06	0.54	0.00	0.00	0.00	0.00	0.00	0.00	0.60
f	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.06
g	0.04	0.06	0.00	0.02	0.00	0.02	0.00	0.00	0.00	0.15
h	0.00	0.00	2.08	0.06	0.00	0.00	0.00	0.00	0.00	2.15
i	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
j	0.00	0.10	0.94	0.00	0.00	0.00	0.00	0.00	0.00	1.04
k	0.08	0.54	0.25	2.90	0.00	0.02	0.00	0.00	0.00	3.79
l	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08
m	0.00	0.06	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.15
n	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
o	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
q	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06
r	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
s	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
y	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
z	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
	0.50	1.13	4.00	3.17	0.00	0.04	0.00	0.00	0.00	8.84

Percentage of grand total. Age= 14

	1	2	3	4	5	6	7	8	9	
a	0.21	0.04	0.04	0.21	0.00	0.00	0.00	0.02	0.00	0.52
b	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.02
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
e	0.00	0.02	0.56	0.00	0.00	0.00	0.00	0.00	0.00	0.58
f	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.06
g	0.02	0.04	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.08
h	0.00	0.00	1.79	0.02	0.00	0.00	0.00	0.00	0.00	1.81
i	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
j	0.00	0.02	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.42
k	0.04	0.17	0.08	2.10	0.00	0.00	0.00	0.00	0.00	2.40
l	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
n	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
q	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
r	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
s	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.02
v	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
y	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
z	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.02
	0.31	0.31	2.96	2.33	0.00	0.06	0.00	0.02	0.00	6.00

Appendix 6:Ce. Continued.

Percentage of grand total. Age= 15

	1	2	3	4	5	6	7	8	9	
a	0.06	0.02	0.02	0.02	0.00	0.02	0.00	0.00	0.00	0.15
b	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.13
f	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02
g	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
h	0.00	0.02	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.48
i	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
j	0.00	0.02	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.21
k	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.17
l	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
n	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
q	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
r	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
s	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
y	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
z	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.06	0.08	0.81	0.19	0.00	0.02	0.00	0.00	0.00	1.17

Percentage of grand total. Age= 16

	1	2	3	4	5	6	7	8	9	
a	0.04	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.06
b	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.02
c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.25
f	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02
g	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.02
h	0.00	0.00	1.60	0.00	0.00	0.00	0.00	0.00	0.00	1.60
i	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
j	0.00	0.00	0.31	0.00	0.00	0.00	0.00	0.00	0.00	0.31
k	0.00	0.04	0.00	0.10	0.00	0.04	0.00	0.00	0.00	0.19
l	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
n	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
o	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
q	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
r	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
s	0.00	0.00	0.02	0.00	0.00	0.04	0.00	0.00	0.00	0.06
t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
u	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
w	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
y	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
z	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.08
	0.04	0.06	2.23	0.13	0.00	0.19	0.00	0.00	0.00	2.65

Appendix 6:D

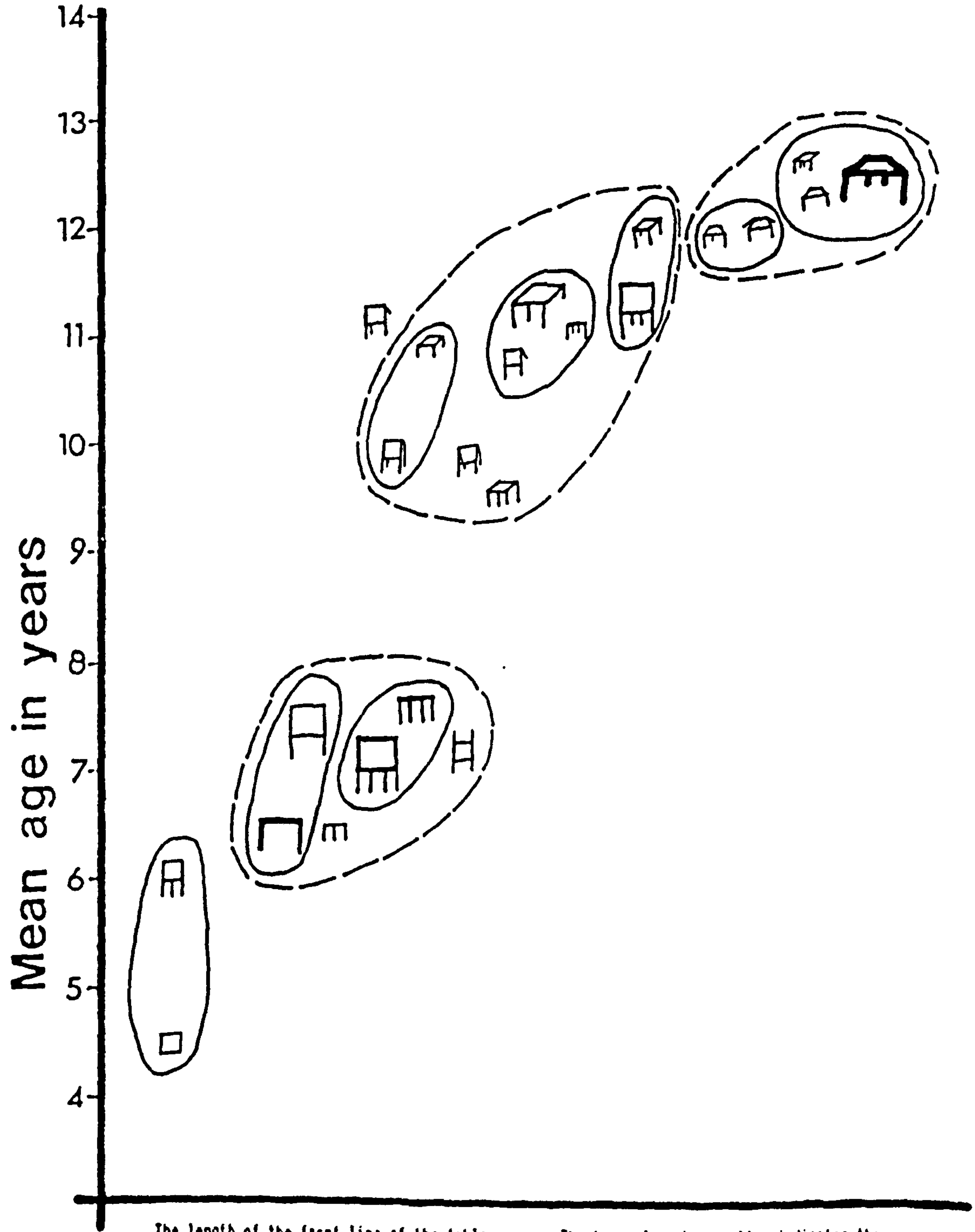
Venn diagrams and dendrograms for tables drawn from observation, and the information upon which they are based.

This appendix is presented in two sections. It contains an analysis of data by cell type for cells accounting for more than 0.5 percent of all tables drawn from observation as well as an analysis of all the data. This has been done to enable trends shown in the data to be more easily assimilated. Similarly, each dendrogram has been presented twice. A reduced version has been produced to facilitate an overall view of the data. This is followed by a larger, more readable, version

The dendrograms are constructed by comparing the age profiles for each cell (given in appendices d) using a series of Kolmogorov-Smirnov comparisons. On each pass the two cells with the smallest maximum difference (SMD) are identified and the data in these cells are amalgamated. Appendices e give the series of amlagamations and smd's.

1) Breakdown of data by cell type for cells accounting for more than 0.5 percent of all tables drawn from observation. Page

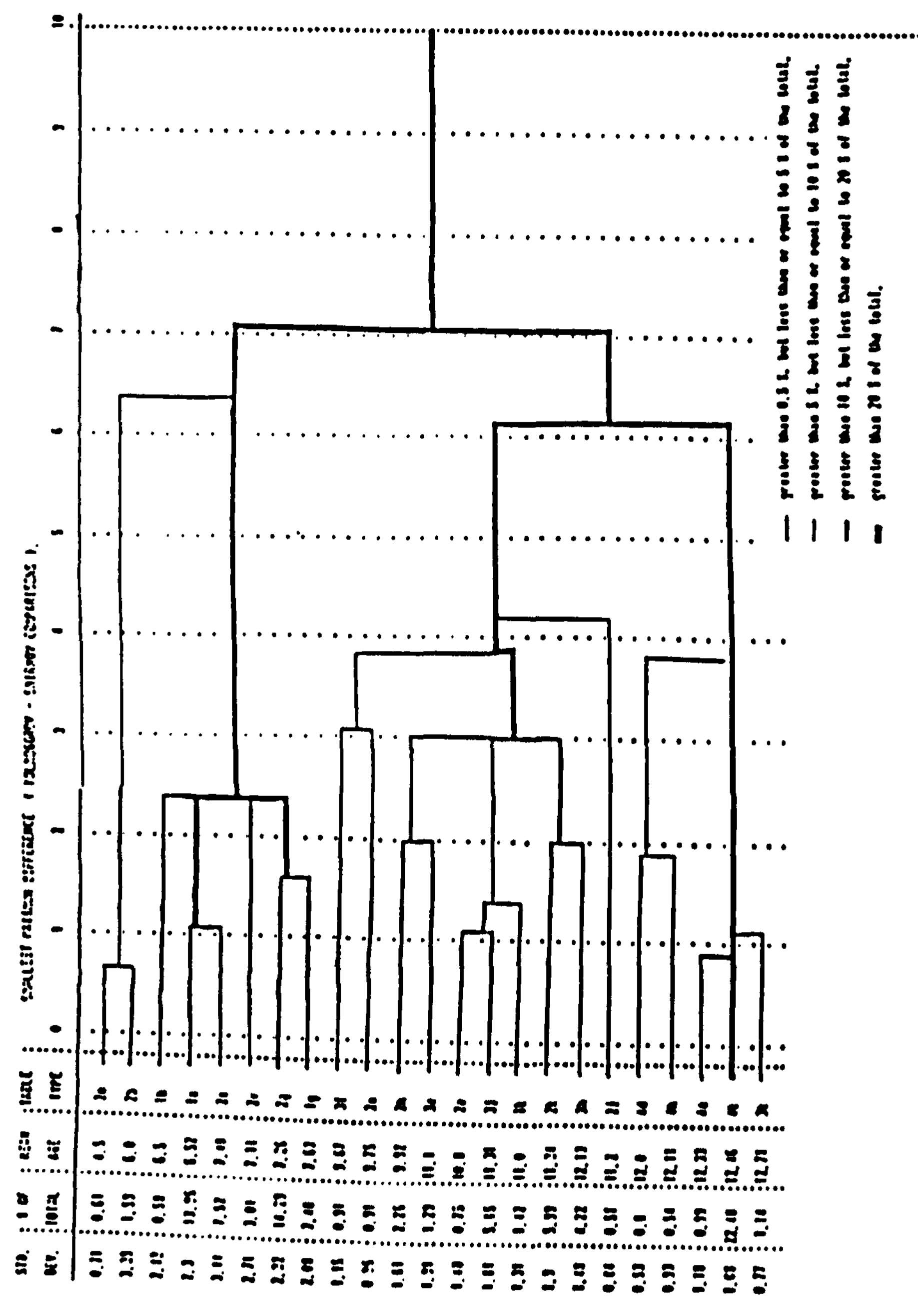
Ap.6:D,1a. Venn diagram of cells accounting for more than 0.5 percent of all tables drawn from observation.



The length of the front line of the table top indicates approximately the percentage of the total accounted for by that table type.
0% to 0.5%
0.5% to 5%
5% to 10%
10% to 20%
Greater than 20%

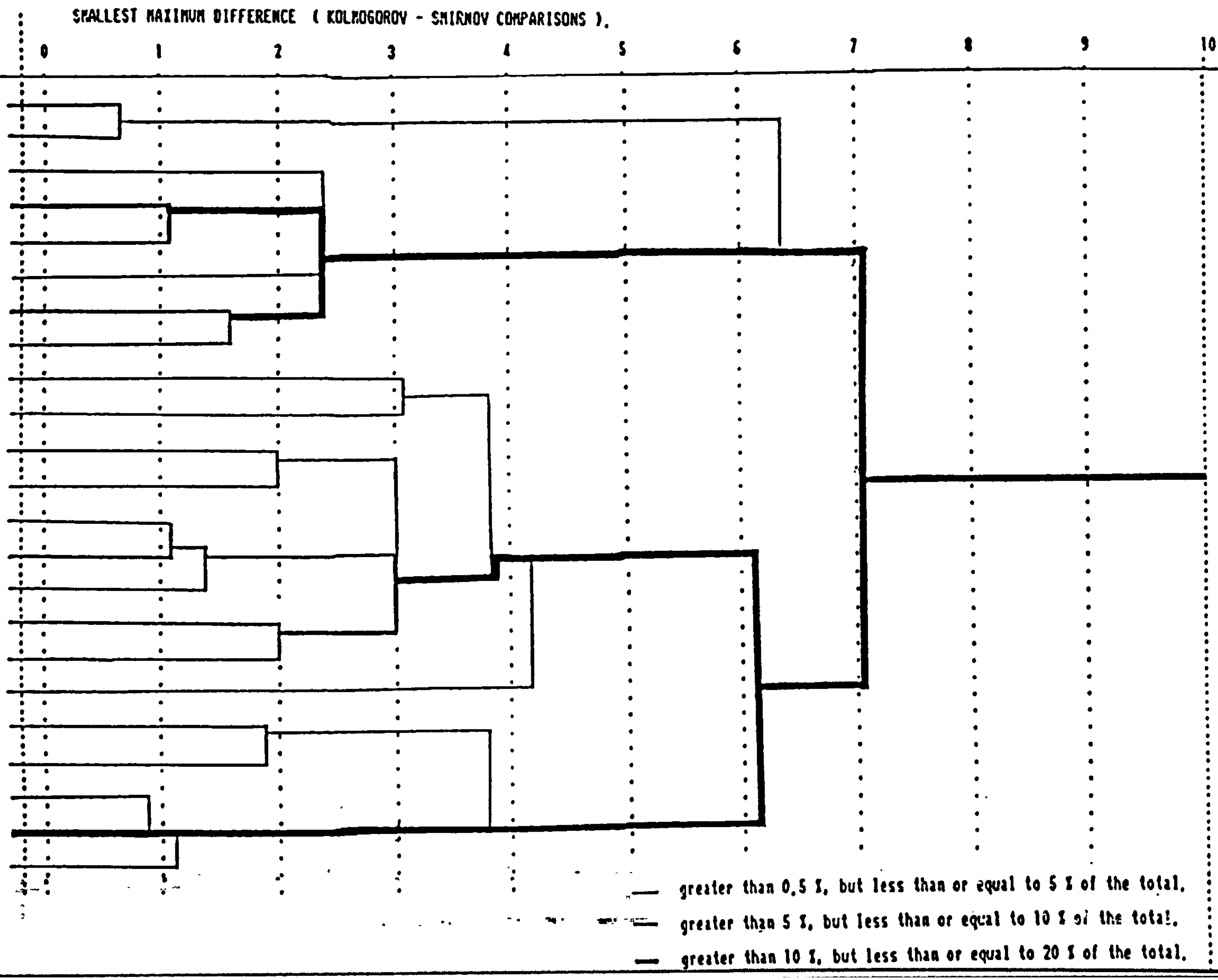
The type of enclosure line indicates the smallest maximum difference between age profiles (Kolmogorov - Smirnov comparisons).
0 to 2
2 to 4
4 to 6
No line, greater than 6.

Ap.6:D,1b. Reduced dendrogram of cells accounting for more than 0.5 percent of all tables drawn from observation.



Ap.6:D,1c. Dendrogram of cells accounting for more than 0.5 percent of all tables drawn from observation.

STD. DEV.	% OF TOTAL	MEAN AGE	TABLE TYPE
0.71	0.61	4.5	2o
3.39	1.59	6.0	2b
2.12	0.58	6.5	1b
2.3	13.96	6.52	1a
3.11	7.52	7.48	2a
2.71	3.01	7.11	2v
2.32	14.29	7.26	2g
2.08	7.40	7.63	1g
1.15	0.91	9.67	3f
0.96	0.91	9.75	2m
1.61	2.26	9.92	2h
1.91	1.29	11.1	3e
1.48	0.75	10.8	2e
1.81	5.15	11.31	3j
1.31	1.42	11.0	1k
1.9	5.99	11.34	2k
1.48	4.22	12.13	3h
0.84	0.51	11.2	2j
0.53	0.8	12.0	4d
0.93	0.54	12.11	4h
1.18	0.99	12.33	4a
1.08	22.48	12.46	4k
0.77	1.14	12.71	3k



Ap.6:D,1d. Age profiles for cells accounting for more than 0.5 percent of all tables drawn from observation.

Column number

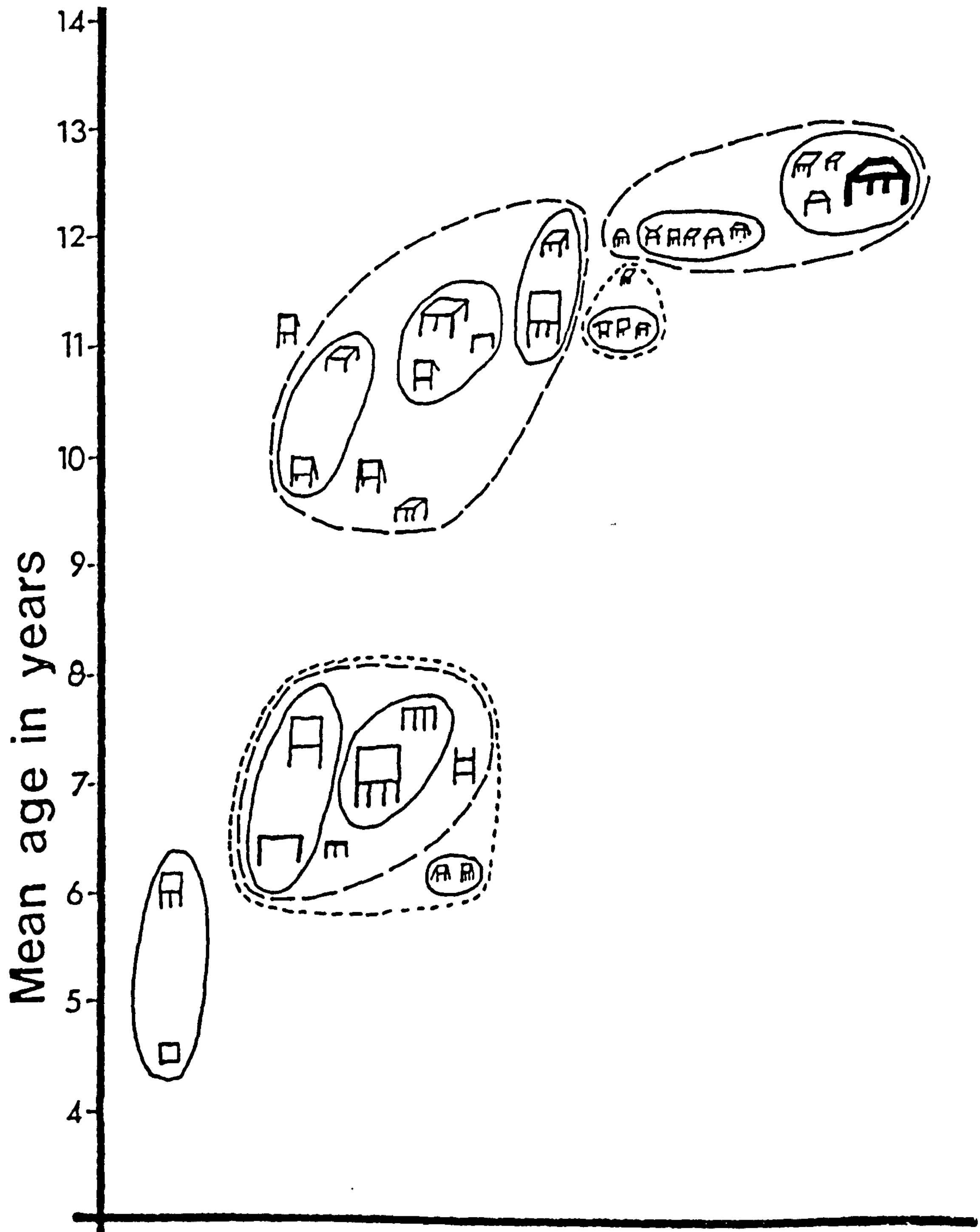
1	2	3	4	5	6	7	8	9	10	11	12	13
1a	1b	1g	1k	2a	2b	2e	2g	2h	2j	2k	2m	2o
25		3,57		21,43	10,71		21,43					3,57
43,75	3,13	6,25		12,5	6,25		21,88			3,13		3,13
34,38		25		12,5			15,63					
21,88		15,63		12,5			37,5	3,13		6,25		
3,33	3,33	16,67		6,67			23,33	6,67		16,67		
12,5		9,38	3,13	6,25		3,13	21,88	6,25			6,25	
9,38		3,13	9,38	6,25		3,13	12,5	6,25	3,13	6,25	3,13	
2,72		2,04	1,36	0,68		1,36	1,36	2,04	1,36	11,56	0,68	
0,56		0,56	1,12	2,25	0,56			0,56	1,12	10,11		
			0,63	0,63		0,63	0,63			7,55		
				1,09			1,09			4,34		
153,5	6,4601	82,23	15,62	82,75	17,52	8,2501	157,23	24,9	5,6101	65,86	10,06	6,7001
13,955	0,5873	7,4755	1,42	7,5227	1,5927	0,75	14,294	2,2636	0,51	5,9873	0,9146	0,6091
6,52	6,5	7,63	11,0	7,48	6,0	10,8	7,26	9,92	11,2	11,34	9,75	4,5
2,3	2,12	2,08	1,31	3,11	3,39	1,48	2,32	1,61	0,84	1,9	0,96	0,71
52	2	27	8	29	5	5	53	13	5	62	4	2

14	15	16	17	18	19	20	21	22	23		
2v	3e	3f	3h	3j	3k	4a	4d	4h	4k	total	obtttl-small=<0.5%
										0	3 years old
14,29										100	4
										100,02	5
3,13				3,13						93,77	6
3,13										100,02	7
	6,67		10	3,33					3,33	100	8
3,13		9,38	6,25	12,5						100,03	9
9,38	3,13			21,88					3,13	100,05	10
	1,36	0,68	5,44	5,44	1,36	3,4	1,36	1,36	49,66	95,22	11
	1,12		8,43	1,12	3,37	1,69	6,18	2,81	53,37	94,93	12
	1,89		7,55	8,18	5,66	2,52	1,26	0,63	61,64	99,4	13
			8,7	1,09	2,17	3,26		1,09	76,09	98,92	14
										0	15
										0	adult
33,06	14,17	10,06	46,37	56,67	12,56	10,87	8,8001	5,8901	247,22	1082,4	totals
3,0055	1,2882	0,9146	4,2155	5,1518	1,1418	0,9882	0,8	0,5355	22,475	98,397	percentage totals
7,11	11,1	9,67	12,13	11,31	12,71	12,33	12,0	12,11	12,46		mean age
2,71	1,91	1,15	1,48	1,81	0,77	1,18	0,53	0,93	1,08		standard deviation
9	10	3	47	35	17	15	15	9	342		subject numbers

Ap.6:D,1e. Smallest maximum differences of age profiles for cells accounting for more than 0.5 percent of all tables drawn from observation.

```
column 13 added to column 6 with an smd of 7.846558E-02
column 23 added to column 20 with an smd of 8.578321E-02
column 5 added to column 1 with an smd of 0.110769
column 18 added to column 7 with an smd of 0.1139933
column 20 added to column 19 with an smd of 0.1346802
column 7 added to column 4 with an smd of 0.1398809
column 8 added to column 3 with an smd of 0.1560352
column 22 added to column 21 with an smd of 0.1850595
column 17 added to column 11 with an smd of 0.1981987
column 15 added to column 9 with an smd of 0.2039804
column 14 added to column 1 with an smd of 0.2357153
column 3 added to column 1 with an smd of 0.2284812
column 2 added to column 1 with an smd of 0.2110777
column 11 added to column 4 with an smd of 0.3075353
column 9 added to column 4 with an smd of 0.2605191
column 16 added to column 12 with an smd of 0.3111332
column 21 added to column 19 with an smd of 0.3563133
column 12 added to column 4 with an smd of 0.387605
column 10 added to column 4 with an smd of 0.4201857
column 19 added to column 4 with an smd of 0.606898
column 6 added to column 1 with an smd of 0.6406599
column 4 added to column 1 with an smd of 0.6972582
```

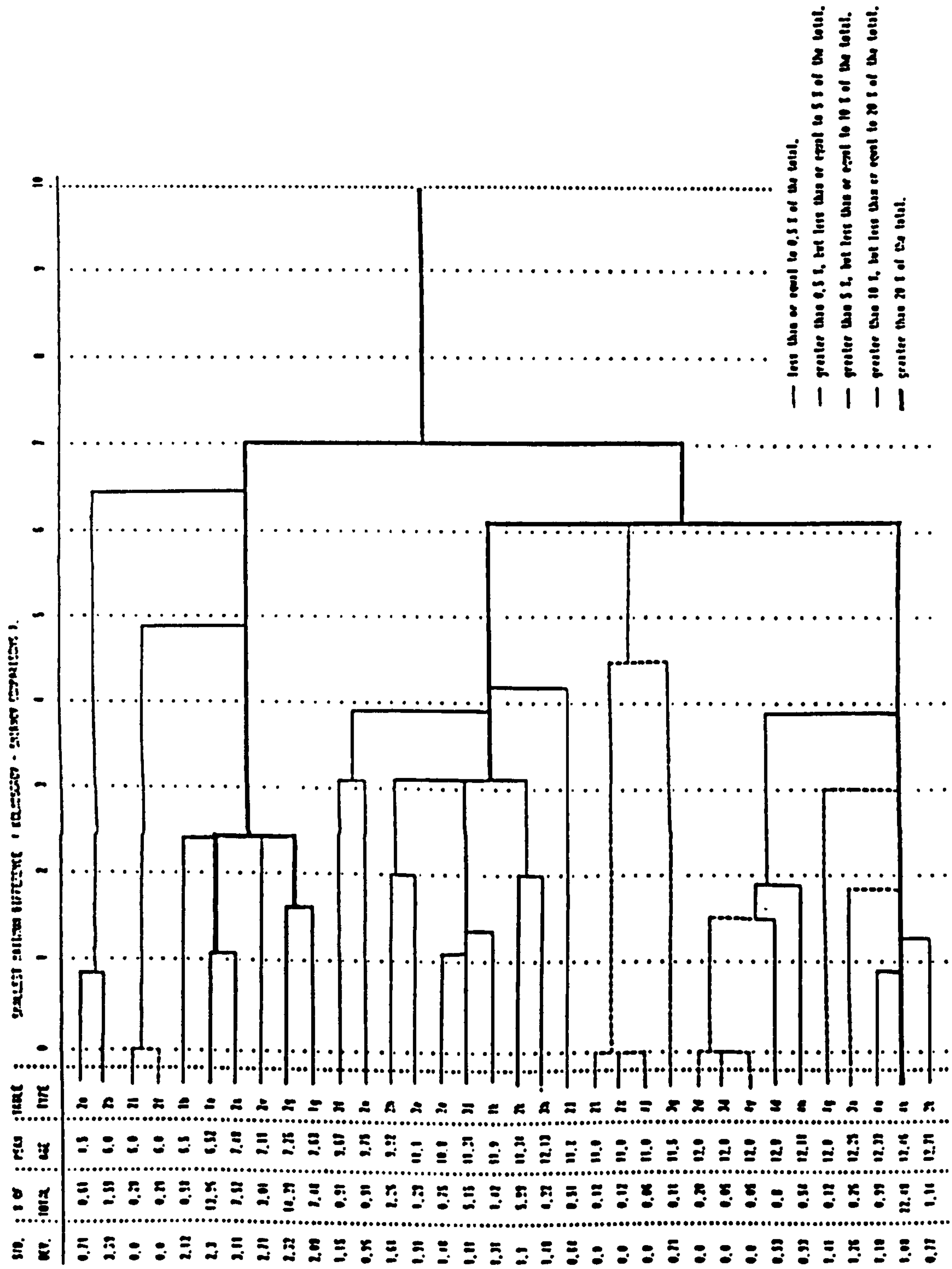
Ap.6:D,2a. Venn diagram of cells of all tables drawn from observation.



The length of the front line of the table top indicates approximately the percentage of the total accounted for by that table type.
0% to 0.5%
0.5% to 5%
5% to 10%
10% to 20%
Greater than 20%

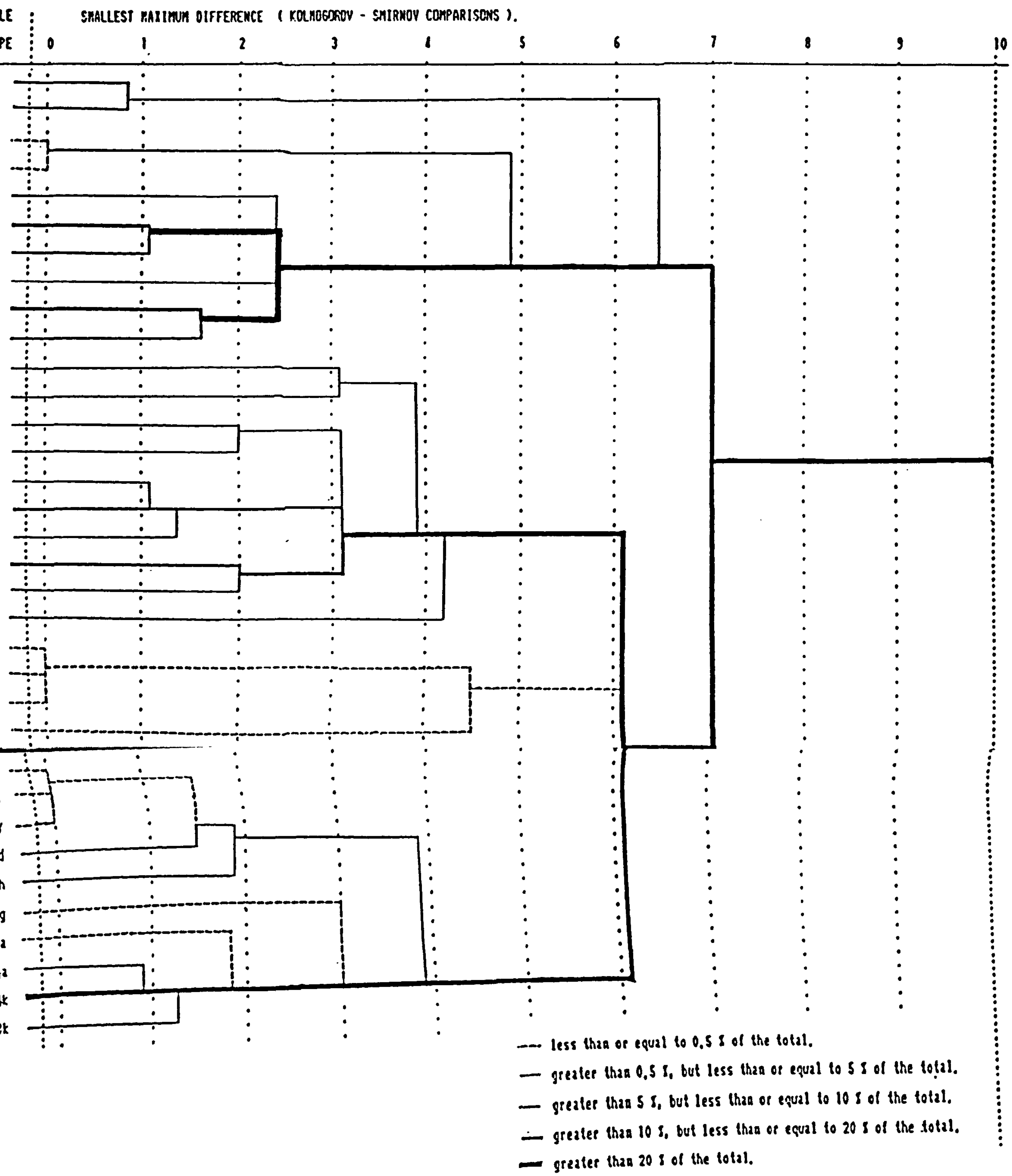
The type of enclosure line indicates the smallest maximum difference between age profiles (Kolmogorov - Smirnov comparisons).
0 to 2
2 to 4
4 to 6
No line, greater than 6.

Ap.6:D,2b. Reduced dendrogram of cells of all tables drawn from observation.



Ap.6:D,2c. Dendrogram of cells of all tables drawn from observation.

STD. DEV.	% OF TOTAL	MEAN AGE	TABLE TYPE
0.71	0.61	4.5	2o
3.39	1.59	6.0	2b
0.0	0.28	6.0	2i
0.0	0.28	6.0	2f
2.12	0.58	6.5	1b
2.3	13.96	6.52	1a
3.11	7.52	7.48	2a
2.71	3.01	7.11	2v
2.32	14.29	7.26	2g
2.08	7.48	7.63	1g
1.15	0.91	9.67	3f
0.96	0.91	9.75	2m
1.61	2.26	9.92	2h
1.91	1.29	11.1	3e
1.48	0.75	10.8	2e
1.81	5.15	11.31	3j
1.31	1.42	11.0	1k
1.9	5.99	11.34	2k
1.48	4.22	12.13	3h
0.84	0.51	11.2	2j
0.0	0.12	11.0	2l
0.0	0.12	11.0	2z
0.0	0.06	11.0	4j
0.71	0.11	11.5	3g
0.0	0.20	12.0	2d
0.0	0.05	12.0	3d
0.0	0.05	12.0	4y
0.53	0.8	12.0	4d
0.93	0.54	12.11	4h
1.41	0.12	12.0	4g
1.26	0.26	12.25	3a
1.18	0.99	12.33	4a
1.08	22.48	12.46	4k
0.77	1.14	12.71	3k



Ap.6:D,2d. Age profiles for cells of all tables drawn from observation.

Column number

1	2	3	4	5	6	7	8	9	10	11	12	13
1a	1b	1g	1k	2a	2b	2d	2e	2f	2g	2h	2i	2j
25		3.57		21.43	10.71				21.43			
43.75	3.13	6.25		12.5	6.25				21.88		3.13	
34.38		25		12.5				3.13	15.63			
21.88		15.63		12.5					37.5	3.13		
3.33	3.33	16.67		6.67					23.33	6.67		
12.5		9.38	3.13	6.25			3.13		21.88	6.25		
9.38		3.13	9.38	6.25			3.13		12.5	6.25		3.13
2.72		2.04	1.36	0.68			1.36		1.36	2.04		1.36
0.56		0.56	1.12	2.25	0.56					0.56		1.12
			0.63	0.63		2.25	0.63		0.63			
				1.09					1.09			
153.5	6.4601	82.23	15.62	82.75	17.52	2.2501	8.2501	3.1301	157.23	24.9	3.1301	5.6101
13.955	0.5873	7.4755	1.42	7.5227	1.5927	0.2046	0.75	0.2846	14.294	2.2636	0.2846	0.51
6.52	6.5	7.63	11.0	7.48	6.0	12.0	10.8	6.0	7.26	9.92	6.0	11.2
2.3	2.12	2.08	1.31	3.11	3.39	0.0	1.48	0.0	2.32	1.61	0.0	0.84
52	2	27	8	29	5	4	5	1	53	13	1	5

14	15	16	17	18	19	20	21	22	23	24	25	26
2k	2l	2m	2o	2v	2z	3a	3d	3e	3f	3g	3h	3j
			3.57	14.29								
3.13			3.13									
				3.13								3.13
6.25				3.13								
16.67								6.67			10	3.33
		6.25		3.13					9.38		6.25	12.5
6.25		3.13		9.38				3.13				21.88
11.56	1.36	0.68			0.68	0.68		1.36	0.68	0.68	5.44	5.44
10.11						1.12	0.56	1.12		0.56	8.43	1.12
7.55								1.89			7.55	8.18
4.34						1.09					8.7	1.09
65.86	1.3601	10.06	6.7001	33.06	0.6801	2.8901	0.5601	14.17	10.06	1.2401	46.37	56.67
5.9873	0.1236	0.9146	0.6091	3.0055	0.0618	0.2627	0.0509	1.2882	0.9146	0.1127	4.2155	5.1518
11.34	11.0	9.75	4.5	7.11	11.0	12.25	12.0	11.1	9.67	11.5	12.13	11.31
1.9	0.0	0.96	0.71	2.71	0.0	1.26	0.0	1.91	1.15	0.71	1.48	1.81
62	2	4	2	9	1	4	1	10	3	2	47	35

Appendix 6:D,2d. Continued.

27	28	29	30	31	32	33	34		
3k	4a	4d	4g	4h	4j	4k	4y	total	obtttl-large
								0	3 years old
								100	4
								103,15	5
								96,9	6
								100,02	7
						3,33		100	8
								100,03	9
						3,13		100,05	10
1,36	3,4	1,36	0,68	1,36	0,68	49,66		99,98	11
3,37	1,69	6,18		2,81		53,37	0,56	97,17	12
5,66	2,52	1,26	0,63	0,63		61,64		102,28	13
2,17	3,26			1,09		76,09		100,01	14
								0	15
								0	adult
12,56	10,87	8,8001	1,3101	5,8901	0,6801	247,22	0,5601	1100,2	totals
1,1418	0,9882	0,8	0,1191	0,5355	0,0618	22,475	0,0509	100,01	percentage totals
12,71	12,33	12,0	12,0	12,11	11,0	12,46	12,0		mean age
0,77	1,18	0,53	1,41	0,93	0,0	1,08	0,0		standard deviation
17	15	15	2	9	1	342	1		subject numbers

Ap.6:D,2e. Smallest maximum differences of age profiles for cells of all tables drawn from observation.

column 19 added to column 15 with an sad of 0
column 32 added to column 15 with an sad of 0
column 34 added to column 21 with an sad of 0
column 17 added to column 6 with an sad of 7,846558E-02
column 33 added to column 28 with an sad of 8,578321E-02
column 5 added to column 1 with an sad of 0,110769
column 26 added to column 8 with an sad of 0,1139933
column 28 added to column 27 with an sad of 0,1346802
column 8 added to column 4 with an sad of 0,1398809
column 29 added to column 21 with an sad of 0,1545455
column 10 added to column 3 with an sad of 0,1560352
column 27 added to column 20 with an sad of 0,1820097
column 31 added to column 21 with an sad of 0,1850594
column 25 added to column 14 with an sad of 0,1981987
column 22 added to column 11 with an sad of 0,2039804
column 18 added to column 1 with an sad of 0,2357153
column 3 added to column 1 with an sad of 0,2284812
column 2 added to column 1 with an sad of 0,2110777
column 30 added to column 20 with an sad of 0,3020034
column 14 added to column 4 with an sad of 0,3075353
column 11 added to column 4 with an sad of 0,2605191
column 23 added to column 16 with an sad of 0,3111332
column 21 added to column 20 with an sad of 0,3683973
column 16 added to column 4 with an sad of 0,387605
column 13 added to column 4 with an sad of 0,4201857
column 24 added to column 15 with an sad of 0,4516129
column 20 added to column 7 with an sad of 0,4631528
column 9 added to column 1 with an sad of 0,4878598
column 12 added to column 6 with an sad of 0,5895954
column 7 added to column 4 with an sad of 0,6074831
column 15 added to column 4 with an sad of 0,3891955
column 6 added to column 1 with an sad of 0,6453361
column 4 added to column 1 with an sad of 0,7026066

Appendix 6:E

Venn diagrams and dendrograms for tables drawn from imagination, and the information upon which they are based.

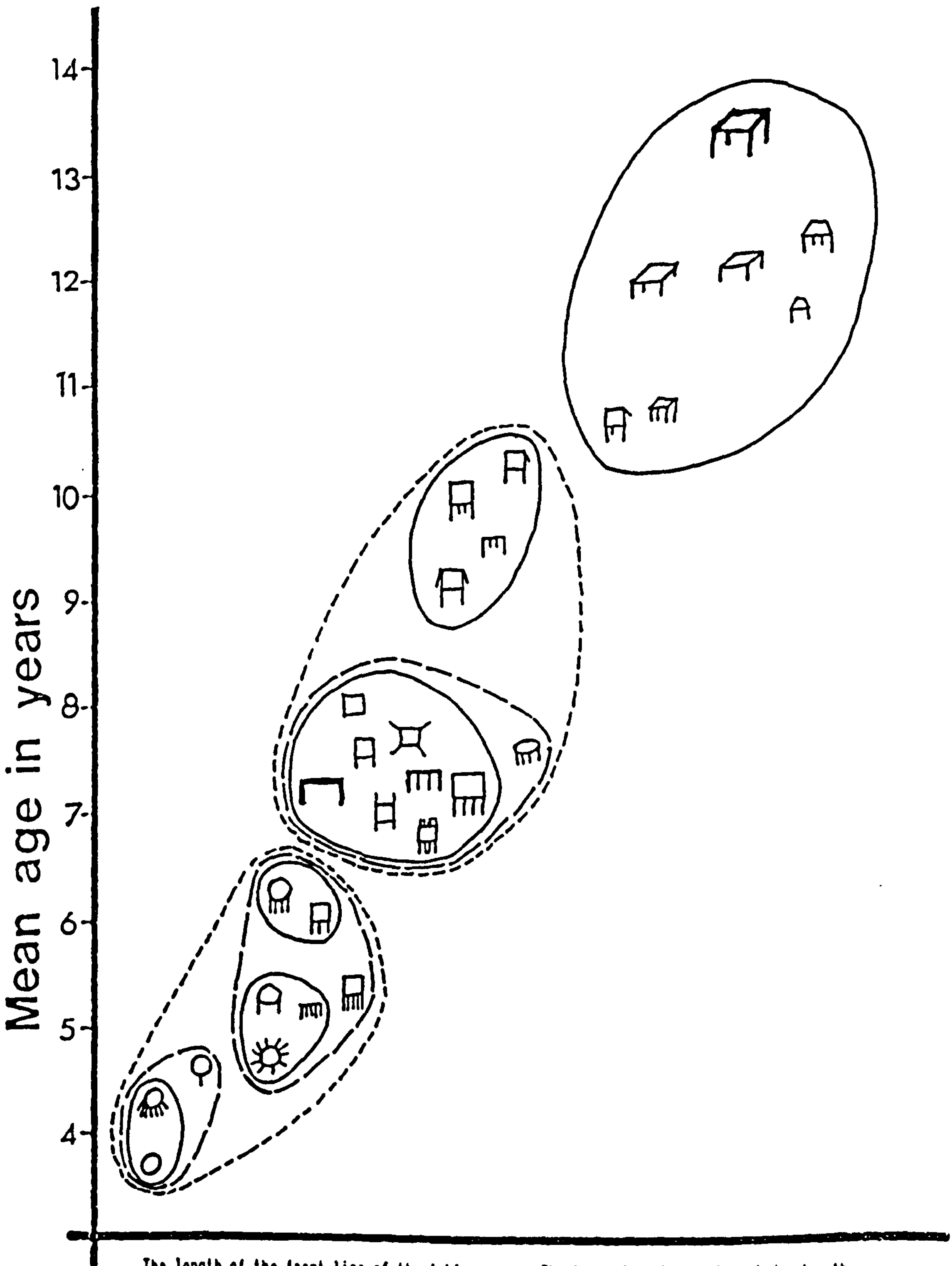
This appendix is presented in two sections. It contains an analysis of data by cell type for cells accounting for more than 0.5 percent of all tables drawn from imagination as well as an analysis of all the data. This has been done to enable trends shown in the data to be more easily assimilated. Similarly, each dendrogram has been presented twice. A reduced version has been produced to facilitate an overall view of the data. This is followed by a larger, more readable, version

The dendrograms are constructed by comparing the age profiles for each cell (given in appendices d) using a series of Kolmogorov-Smirnov comparisons. On each pass the two cells with the smallest maximum difference (SMD) are identified and the data in these cells are amalgamated. Appendices e give the series of amlagamations and smd's.

1) Breakdown of data by cell type for cells accounting for more than 0.5 percent of all tables drawn from imagination. Page

2) Breakdown of data by cell type for cells of all tables drawn from imagination.

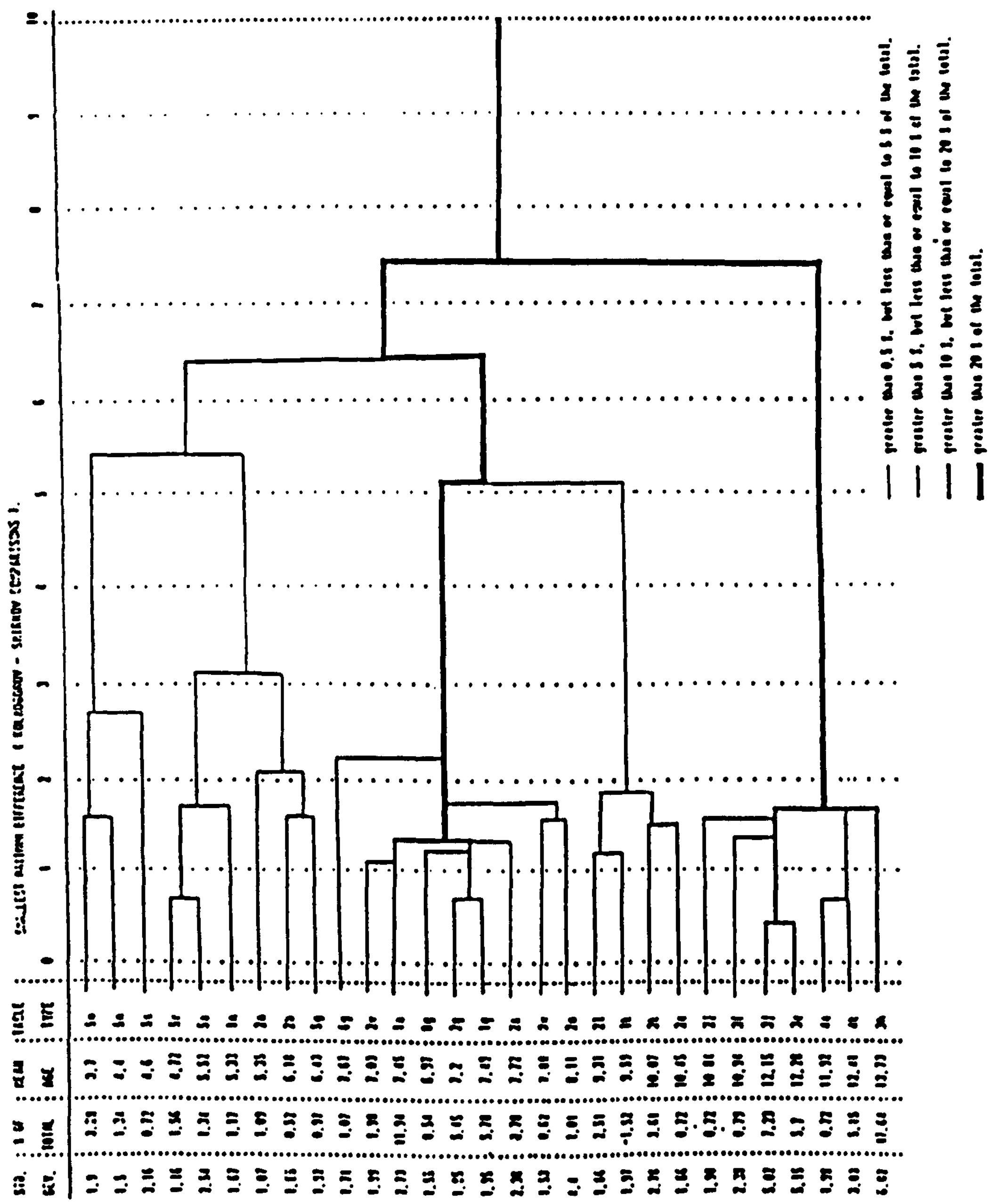
Ap.6:E,1a. Venn diagram of cells accounting for more than 0.5 percent of all tables drawn from imagination.



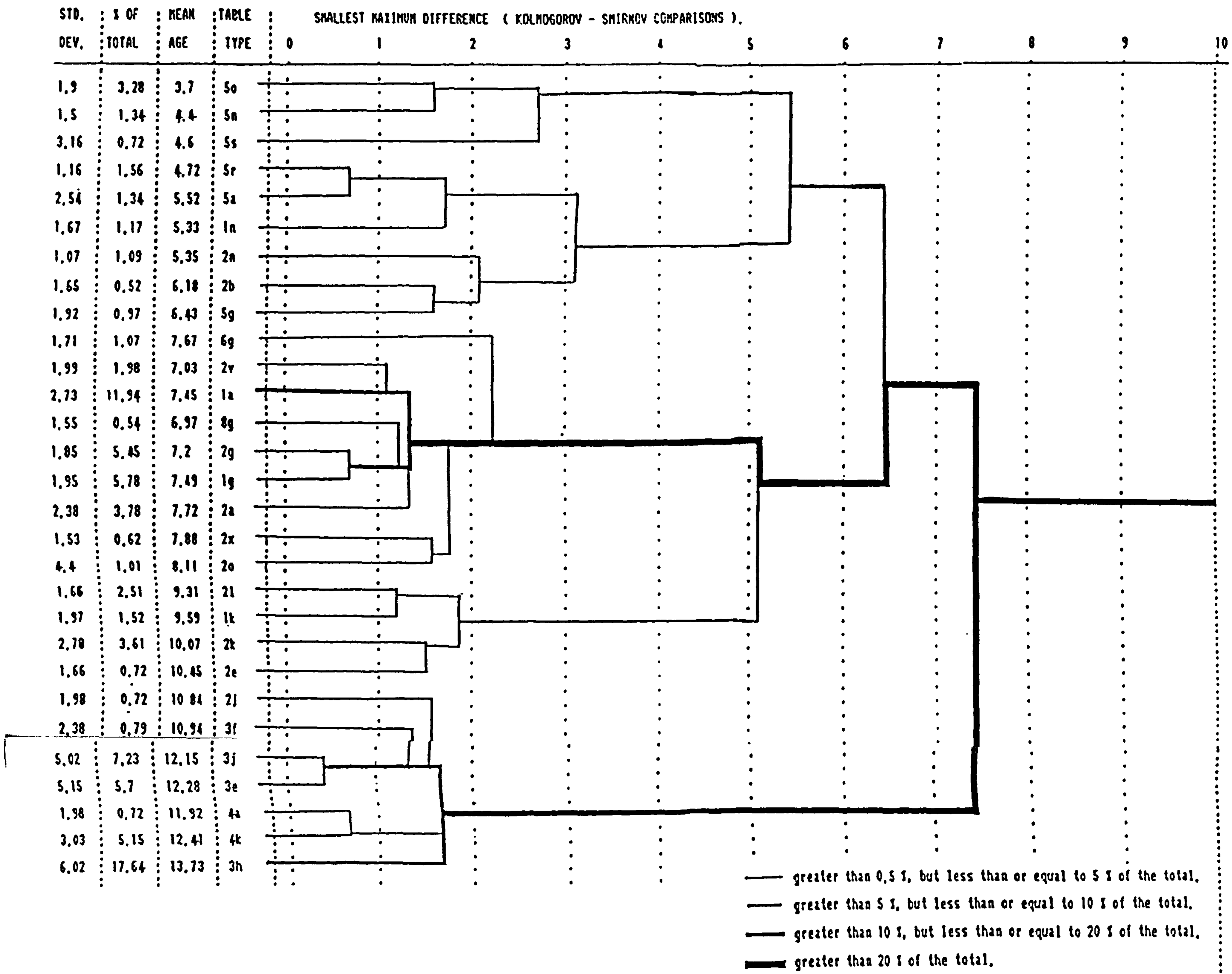
The length of the front line of the table top indicates approximately the percentage of the total accounted for by that table type.
- 0% to 0.5%
- 0.5% to 5%
- 5% to 10%
- 10% to 20%

The type of enclosure line indicates the smallest maximum difference between age profiles (Kolmogorov - Smirnov comparisons).
- 0 to 2
- 2 to 4
- 4 to 6
- No line, greater than 6.

Ap.6:E,1b. Reduced dendrogram of cells accounting for more than 0.5 percent of all tables drawn from imagination.



Ap.6.E.1c. Dendrogram of cells accounting for more than 0.5 percent of all tables drawn from imagination.



Ap.6:E,1d. Age profiles for cells accounting for more than 0.5 percent of all tables drawn from imagination.

Column numbers.

1	2	3	4	5	6	7	8	9	10	11	12	13
1a	1g	1k	1n	2a	2b	2e	2g	2j	2k	2l	2n	2o
4,44			4,44									2,22
27,88	6,67		5,45	8,48	1,82		4,85		0,61		5,45	2,42
23,4	9,29		4,17	6,41	2,24		12,82		1,28	0,32	5,77	1,6
24,87	14,87	1,54	0,26	6,41	1,03	0,51	17,44	0,26	1,79	0,51	2,56	0,51
23,9	18,33	1,62	0,93	5,8	0,23		15,55		2,55	3,71	0,93	1,16
18,99	10,68	3,26	0,59	9,79	1,48	0,3	8,9	0,89	5,04	5,34	0,59	2,67
9,93	9,69	3,31	0,24	4,49	0,47	1,89	7,8	0,71	8,51	10,4		0,95
6,77	5,19	4,74	0,23	3,61		1,35	5,42	1,35	8,35	6,09		0,45
5,13	2,14	1,28		2,14		2,99	1,71	1,5	8,97	3,21		0,43
3,38	2,82	3,38		1,97		1,69	0,56	1,13	4,51	1,69		0,56
6,54	0,77	1,15		1,54		0,77	0,77	1,92	5,38	1,54		0,38
5,05	0,51	1,01		0,51		0,51	0,51	0,51	2,02	0,51		
5,36				1,79				1,79		1,79		
1,57									1,57			0,79
167,21	80,96	21,29	16,31	52,94	7,2701	10,01	76,33	10,06	50,58	35,11	15,3	14,14
11,944	5,7829	1,5207	1,165	3,7814	0,5193	0,715	5,4522	0,7186	3,6129	2,5079	1,0929	1,01
7,45	7,49	9,59	5,33	7,72	6,18	10,45	7,2	10,84	10,07	9,31	5,35	8,11
2,73	1,95	1,97	1,67	2,38	1,65	1,66	1,85	1,98	2,78	1,66	1,07	4,4
525	300	82	33	175	22	40	283	31	191	135	43	38

14	15	16	17	18	19	20	21	22	23	24	25	26
2v	2x	3e	3f	3h	3j	4a	4k	5a	5g	5n	5o	5r
2,22	2,22							8,89	2,22	13,33	40	8,89
1,82								4,85	3,03	2,42	4,85	6,67
5,77	0,32							2,56	2,24	2,56	0,32	4,49
5,38	0,51	0,26		0,26	0,26			0,77	1,79	0,26		1,28
4,87	0,7	0,46		0,46	0,7		0,23		1,62		0,23	0,23
2,97	2,37	1,19	0,3	1,48	2,67	0,3	0,59	0,59	1,19	0	0	0,3
1,89	2,36	3,07	2,13	4,96	5,91	0,95	3,78	0,24	1,18	0,24	0,24	
0,9	0,23	11,51	1,13	16,25	11,29		3,84	0,23			0,23	
1,07		9,62	0,85	22,22	16,24	1,28	5,34					
0,85		10,99	1,41	28,17	14,93	1,13	9,58	0,56	0,28			
		8,85	1,15	33,85	12,31	1,15	13,85					
		13,64	1,52	39,39	9,09	3,54	16,67					
		10,71	1,79	39,29	16,07	1,79	14,29					
		9,45	0,79	60,63	11,81		3,94					
27,74	8,7101	79,75	11,07	246,96	101,28	10,14	72,11	18,69	13,55	18,81	45,87	21,86
1,9814	0,6222	5,6964	0,7907	17,64	7,2343	0,7243	5,1507	1,335	0,9679	1,3436	3,2764	1,5614
7,03	7,88	12,28	10,94	13,73	12,15	11,92	12,41	5,52	6,43	4,4	3,7	4,72
1,99	1,53	5,15	2,38	6,02	5,02	1,98	3,03	2,54	1,92	1,5	1,9	1,16
94	26	223	33	570	291	26	177	29	37	20	30	36

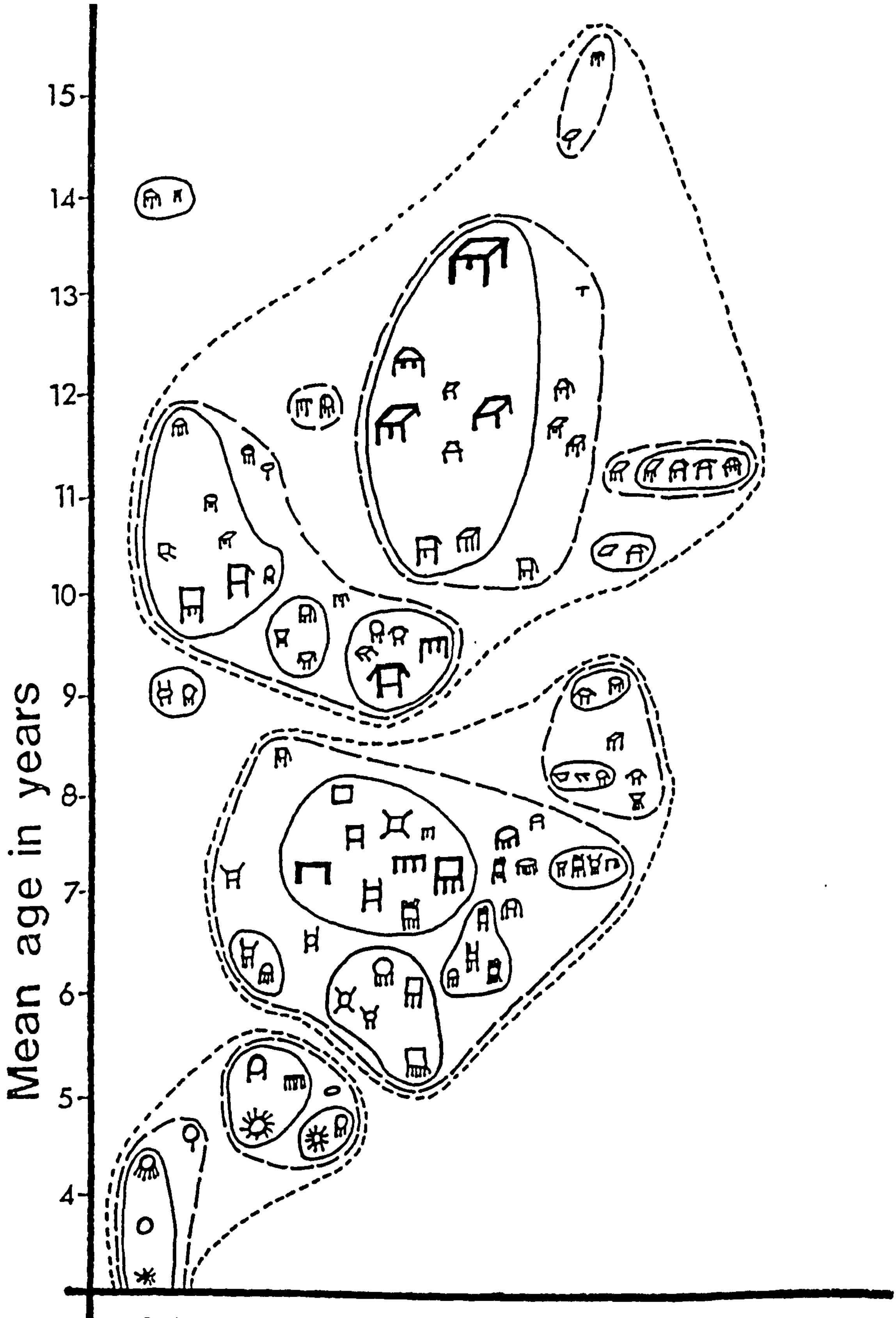
Appendix 6:E,1d. Continued.

27	28	29	
5s	6g	8g	ialttlsa)0.5%of tot
6,67			3 years of age
			4
1,6	0,96	1,29	5
0,26	3,59	2,31	6
	2,32	1,86	7
0,3	4,45	1,19	8
0,24	2,36	0,24	9
0,45		0,45	10
0,21	0,64	0,21	11
0,28	0,28		12
	0,38		13
			14
			15
			adult
10,01	14,98	7,5501	totals
0,715	1,07	0,5393	percentage of total
6,6	7,67	6,97	mean age
3,16	1,71	1,55	standard deviation
15	57	29	number of subjects

Ap.6:E,1e. Smallest maximum differences of age profiles for cells accounting for more than 0.5 percent of all tables drawn from imagination.

column 19 added to column 16 with an smd of 5,879682E-02
column 26 added to column 22 with an smd of 7,295358E-02
column 21 added to column 20 with an smd of 7,627964E-02
column 8 added to column 2 with an smd of 7,917112E-02
column 14 added to column 1 with an smd of 0,1107591
column 11 added to column 3 with an smd of 0,1205912
column 29 added to column 2 with an smd of 0,1216875
column 2 added to column 1 with an smd of 0,1242957
column 5 added to column 1 with an smd of 0,1268891
column 17 added to column 16 with an smd of 0,1393045
column 10 added to column 7 with an smd of 0,1515533
column 15 added to column 13 with an smd of 0,1581764
column 16 added to column 9 with an smd of 0,1611167
column 25 added to column 24 with an smd of 0,1633641
column 23 added to column 6 with an smd of 0,1638376
column 22 added to column 4 with an smd of 0,1662454
column 20 added to column 9 with an smd of 0,1699065
column 18 added to column 9 with an smd of 0,1541233
column 13 added to column 1 with an smd of 0,1781743
column 7 added to column 3 with an smd of 0,1930026
column 12 added to column 6 with an smd of 0,2104518
column 28 added to column 1 with an smd of 0,220868
column 27 added to column 24 with an smd of 0,2705865
column 6 added to column 4 with an smd of 0,3426144
column 3 added to column 1 with an smd of 0,5064165
column 24 added to column 4 with an smd of 0,5404682
column 4 added to column 1 with an smd of 0,6400966
column 9 added to column 1 with an smd of 0,7492217

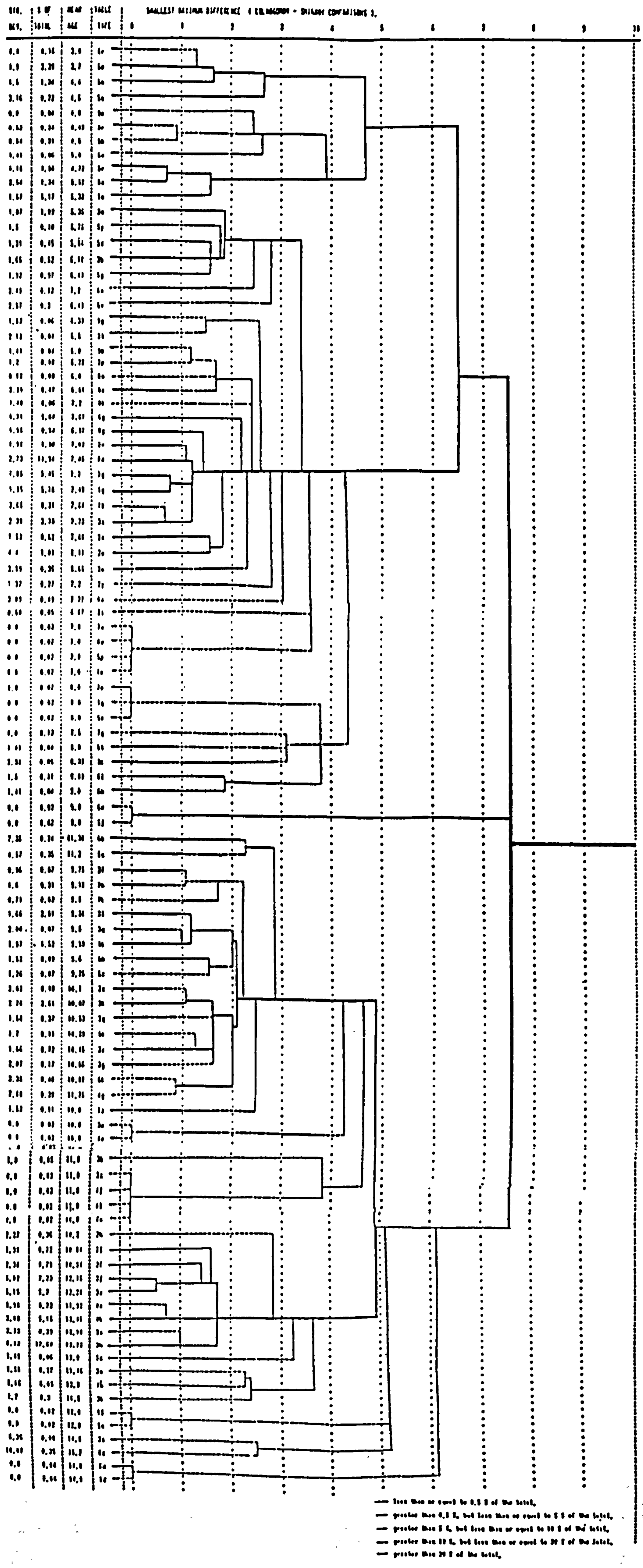
Ap.6:E,2a. Venn diagram of cells of all tables drawn from imagination.



The length of the front line of the table top indicates approximately the percentage of the total accounted for by that table type.
0% to 0.5% 5% to 10%
0.5% to 5% 10% to 20%

The type of enclosure line indicates the smallest maximum difference between age profiles (Kolmogorov - Smirnov comparisons).
0 to 2 4 to 6
2 to 4 No line, greater than 6.

Ap.6:E,2b. Reduced dendrogram of cells of all tables drawn from imagination.



Ap.6:E,2C. Dendrogram of cells of all tables drawn from imagination.

STD. DEV.	% OF TOTAL	MEAN AGE	TABLE TYPE
0.0	0.16	3.0	6r
1.9	3.28	3.7	5o
1.5	1.34	4.4	5n
3.16	0.72	4.6	5s
0.0	0.04	4.0	9o
0.53	0.24	4.43	2r
0.84	0.21	4.5	5b
1.41	0.06	5.0	6o
1.16	1.56	4.72	5r
2.54	1.34	5.52	5a
1.67	1.17	5.33	1n
1.07	1.09	5.35	2n
1.5	0.10	5.75	5y
1.21	0.45	5.84	5x
1.65	0.52	6.18	2b
1.92	0.97	6.43	5g
3.49	0.12	7.2	6n
2.57	0.2	6.43	5v
1.53	0.06	6.33	9g
2.12	0.04	6.5	2t
1.41	0.04	6.0	9b
1.2	0.18	6.22	2p
0.82	0.08	6.0	8n
2.29	0.47	6.61	8a
1.48	0.06	7.2	9k
1.71	1.07	7.67	6g
1.55	0.54	6.97	8g
1.99	1.98	7.03	2v
2.73	11.94	7.45	1a
1.85	5.45	7.2	2g
1.95	5.78	7.49	1g
2.65	0.31	7.64	1b
2.38	3.78	7.72	2a
1.53	0.62	7.88	2x
4.4	1.01	8.11	2o
2.89	0.35	8.65	2m
1.37	0.27	7.2	2y
3.09	0.49	7.77	6a
0.58	0.05	6.67	2i
0.0	0.02	7.0	7a
0.0	0.02	7.0	8u
0.0	0.02	7.0	5p
0.0	0.02	7.0	1e
0.0	0.02	8.0	7o
0.0	0.02	8.0	1q
0.0	0.02	8.0	5e
1.0	0.13	7.5	7g
1.41	0.04	8.0	5l
2.31	0.05	8.33	3c
1.6	0.11	8.83	6l
1.41	0.04	9.0	6h
0.0	0.02	9.0	6v
0.0	0.02	9.0	5j
7.35	0.24	11.38	6b
4.57	0.35	11.2	6s
0.96	0.07	9.75	2f
1.6	0.21	9.13	7h
0.71	0.03	9.5	7k
1.66	2.51	9.31	2l
2.08	0.07	9.5	3q
1.97	1.52	9.59	1k
1.52	0.09	9.6	8h
1.26	0.07	9.75	5z
2.02	0.18	10.1	2z
2.78	3.61	10.07	2k
1.68	0.37	10.53	2q
1.7	0.11	10.29	5k
1.66	0.72	10.45	2e
2.07	0.17	10.56	3g
3.35	0.48	10.87	6k
7.18	0.28	11.75	4g
1.53	0.11	10.0	1z
0.0	0.02	10.0	3o
0.0	0.02	10.0	4e
1.0	0.05	11.0	3b
0.0	0.02	11.0	3z
0.0	0.03	11.0	4j
0.0	0.02	11.0	4l
0.0	0.02	11.0	4m
2.27	0.36	10.2	2h
1.98	0.72	10 84	2j
2.38	0.79	10.94	3f
5.02	7.23	12.15	3j
5.15	5.7	12.28	3e
1.98	0.72	11.92	4a
3.03	5.15	12.41	4k
2.23	0.39	12.18	3a
6.02	17.64	13.73	3h
1.41	0.06	13.0	1s
1.51	0.27	11.45	3m
1.15	0.09	12.0	4h
1.7	0.3	11.5	3k
0.0	0.02	12.0	1j
0.0	0.02	12.0	5m
6.36	0.08	14.5	3s
10.07	0.35	15.7	6z
0.0	0.04	14.0	6u
0.0	0.04	14.0	1d

— less than or equal to 0.5 % of the total.
— greater than 0.5 %, but less than or equal to 5 % of the total.
— greater than 5 %, but less than or equal to 10 % of the total.
— greater than 10 %, but less than or equal to 20 % of the total.
— greater than 20 % of the total.

Ap.6:E,2d. Age profiles for cells of all tables drawn from imagination.

Column numbers.

52	63	54	55	56	57	58	59	60	61	62	63	64
1a	1b	1d	1e	1g	1j	1k	1n	1q	1s	1z	2a	2b
4.44							4.44					
27.88	0.61			6.67			5.45				8.48	1.82
23.4	0.64			9.29			4.17				6.41	2.24
24.87	0.77			14.87		1.54	0.26				6.41	1.03
23.9	0.23		0.23	18.33		1.62	0.93			0.23	5.8	0.23
18.99	0.89			10.68		3.26	0.59	0.3			9.79	1.48
9.93	0.24			9.69		3.31	0.24			0.24	4.49	0.47
6.77	0.23			5.19		4.74	0.23			0.23	3.61	
5.13				2.14		1.28				0.85	2.14	
3.38	0.28			2.82	0.28	3.38			0.28		1.97	
6.54	0.38			0.77		1.15					1.54	
5.05		0.51		0.51		1.01			0.51		0.51	
5.36											1.79	
1.57												
167.21	4.2701	0.5101	0.2301	80.96	0.2801	21.29	16.31	0.3001	0.7901	1.5501	52.94	7.2701
11.944	0.305	0.0364	0.0164	5.7829	0.02	1.5207	1.165	0.0214	0.0564	0.1107	3.7814	0.5193
7.45	7.64	14.0	7.0	7.49	12.0	9.59	5.33	8.0	13.0	10.0	7.72	6.18
2.73	2.65	0.0	0.0	1.95	0.0	1.97	1.67	0.0	1.41	1.53	2.38	1.65
525	14	1	1	300	1	82	33	1	2	7	175	22

65	66	67	68	69	70	71	72	73	74	75	76	77
2e	2f	2g	2h	2i	2j	2k	2l	2m	2n	2o	2p	2q
										2.22		
		4.85				0.61			5.45	2.42		
		12.82				1.28	0.32	0.64	5.77	1.6	1.28	
0.51		17.44	0.26	0.26	0.26	1.79	0.51	1.03	2.56	0.51		
		15.55	0.46	0.46		2.55	3.71	0.23	0.93	1.16	0.93	
0.3		8.9			0.89	5.04	5.34	0.59	0.59	2.67	0.3	0.59
1.89	0.47	7.8	0.24		0.71	8.51	10.4	0.47		0.95		0.95
1.35	0.23	5.42	0.68		1.35	8.35	6.09	0.23		0.45		1.13
2.99	0.21	1.71	1.07		1.5	8.97	3.21	0.21		0.43		0.21
1.69		0.56	0.56		1.13	4.51	1.69	0.28		0.56		1.13
0.77		0.77			1.92	5.38	1.54	1.15		0.38		1.15
0.51		0.51			0.51	2.02	0.51					
			1.79		1.79		1.79					
						1.57				0.79		
10.01	0.9101	76.33	5.0601	0.7201	10.06	50.58	35.11	4.8301	15.3	14.14	2.5101	5.1601
0.715	0.065	5.4522	0.3614	0.0514	0.7186	3.6129	2.5079	0.345	1.0929	1.01	0.1793	0.3686
10.45	9.75	7.2	10.2	6.67	10.84	10.07	9.31	8.65	5.35	8.11	6.22	10.53
1.66	0.96	1.85	2.27	0.58	1.98	2.78	1.66	2.89	1.07	4.4	1.2	1.68
40	4	283	15	3	31	191	135	17	43	38	9	19

Appendix 6:E,2d. Continued.

78	79	80	81	82	83	84	85	86	87	88	89	90
2r	2t	2v	2x	2y	2z	3a	3b	3c	3e	3f	3g	3h
		2,22	2,22									
2,42		1,82										
0,96	0,32	5,77	0,32									
		5,38	0,51	1,28					0,26			0,26
		4,87	0,7	1,39	0,46			0,46	0,46		0,23	0,46
	0,3	2,97	2,37	0,59					1,19	0,3		1,48
		1,89	2,36	0,24	0,24	0,47			3,07	2,13	0,47	4,96
		0,9	0,23		0,68	0,23	0,23		11,51	1,13	0,23	16,25
		1,07		0,21	0,21	0,43	0,21	0,21	9,62	0,85	0,43	22,22
		0,85			0,56	0,85	0,28		10,99	1,41	0,56	28,17
					0,38	0,38			8,85	1,15		33,85
						0,51			13,64	1,52	0,51	39,39
						1,79			10,71	1,79		35,29
						0,79			9,45	0,79		60,63
3,3801	0,6201	27,74	8,7101	3,7101	2,5301	5,4501	0,7201	0,6701	79,75	11,07	2,4301	246,96
0,2414	0,0443	1,9814	0,6222	0,265	0,1807	0,3893	0,0514	0,0479	5,6964	0,7907	0,1736	17,64
4,43	6,5	7,03	7,88	7,2	10,1	12,18	11,0	8,33	12,28	10,94	10,56	13,73
0,53	2,12	1,99	1,53	1,37	2,02	2,23	1,0	2,31	5,15	2,38	2,07	6,02
7	2	94	26	15	10	11	3	3	223	33	9	570

91	92	93	94	95	96	97	98	1	2	3	4	6
3j	3k	3m	3o	3q	3s	3z	4a	4e	4g	4h	4j	4k
0,26												
0,7				0,23					0,23			0,23
2,67		0,3					0,3		0,59			0,59
5,91	0,47			0,24			0,95		0,71			3,78
11,29	0,45	0,45	0,23	0,23				0,23	0,45			3,84
16,24	0,85	0,64				0,21	1,28		0,85	0,43	0,43	5,34
14,93	0,28	0,85		0,28			1,13		0,28			9,58
12,31	1,15	1,54			0,38		1,15			0,77		13,85
9,09	1,01						3,54					16,67
16,07							1,79					14,29
11,81					0,79				0,79			3,94
101,28	4,2101	3,7801	0,2301	0,9801	1,1701	0,2101	10,14	0,2301	3,9001	1,2001	0,4301	72,11
7,2343	0,3007	0,27	0,0164	0,07	0,0836	0,015	0,7243	0,0164	0,2786	0,0857	0,0307	5,1507
12,15	11,5	11,46	10,0	9,5	14,5	11,0	11,92	10,0	11,75	12,0	11,0	12,41
5,02	1,7	1,51	0,0	2,08	6,36	0,0	1,98	0,0	7,18	1,15	0,0	3,03
291	14	13	1	4	2	1	26	1	14	4	2	177

Appendix 6:E,2d. Continued.

6	7	8	9	10	11	12	13	14	15	16	17	18
4l	4a	5a	5b	5e	5g	5h	5j	5k	5l	5m	5n	5o
		8,89			2,22						13,33	40
		4,85	2,42		3,03						2,42	4,85
		2,56	0,32		2,24						2,56	0,32
		0,77	0,26		1,79						0,26	
					1,62			0,23	0,23			0,23
		0,59		0,3	1,19	0,59					0	0
		0,24			1,18		0,24	0,24	0,29		0,24	0,24
		0,23				0,23						0,23
0,21	0,21					0,43		0,85				
		0,56			0,28			0,28		0,28		
0,2101	0,2101	18,69	3,0001	0,3001	13,55	1,2501	0,2401	1,6001	0,5201	0,2801	18,81	45,87
0,015	0,015	1,335	0,2143	0,0214	0,9679	0,0893	0,0172	0,1143	0,0372	0,02	1,3436	3,2764
11,0	11,0	5,52	4,5	8,0	6,43	9,60	9,0	10,29	8,0	12,0	4,4	3,7
0,0	0,0	2,54	0,84	0,0	1,92	1,52	0,0	1,7	1,41	0,0	1,5	1,9
1	1	29	6	1	37	5	1	7	2	1	20	30

19	20	21	22	23	24	25	26	27	28	29	30	31
5p	5r	5s	5v	5x	5y	5z	6a	6b	6g	6h	6k	6l
	8,89	6,67					2,22					
	6,67		1,82	2,42	0,61			0,61				
	4,49	1,6		0,64	0,32		0,32		0,96			
	1,28	0,26	0,26	1,79			1,03		3,59			0,26
0,23	0,23			1,16	0,46		0,23		2,32		0,23	
	0,3	0,3	0,3	0,3		0,3	0,3	0,89	4,45	0,3	0,59	0,3
		0,24	0,24				0,47	0,24	2,36		1,42	0,24
		0,45	0,23			0,45	0,23			0,23	0,68	0,68
		0,21				0,21	0,21		0,64		1,5	
		0,28						0,28	0,28		0,28	
									0,38		0,38	
								0,51				
							1,79					
								0,79			1,57	
0,2301	21,86	10,01	2,8501	6,3101	1,3901	0,9601	6,8001	3,3201	14,98	0,5301	6,6501	1,4801
0,0164	1,5614	0,715	0,2036	0,4507	0,0993	0,0686	0,4857	0,2372	1,07	0,0379	0,475	0,1057
7,0	4,72	6,6	6,43	5,84	5,75	9,75	7,77	11,38	7,67	9,0	10,87	8,83
0,0	1,16	3,16	2,57	1,21	1,5	1,26	3,09	7,35	1,71	1,41	3,35	1,6
1	36	15	7	19	4	4	13	8	57	2	23	6

Appendix 6:E,2d. Continued.

32	33	34	35	36	37	38	39	40	41	42	43	44	
6n	6o	6r	6s	6u	6v	6z	7a	7g	7h	7k	7o	8a	iatttllg
		2,22											3 years of age
0,61	0,61												4
0,64									0,32			2,56	5
	0,26		0,26									2,05	6
			0,23				0,23	0,7				0,7	7
			0,59			0,3		0,89			0,3	0,3	8
			0,47		0,24	0,24		0,24	1,18	0,24		0,24	9
			0,23						0,9	0,23			10
0,43			0,43			0,43			0,21				11
			1,13			0,28			0,28			0,28	12
													13
				0,51		0,51						0,51	14
													15
			1,57			3,15							adult
1,6801	0,8701	2,2201	4,9101	0,5101	0,2401	4,9101	0,2301	1,8301	2,8901	0,4701	0,3001	6,6401	totals
0,12	0,0622	0,1586	0,3507	0,0364	0,0172	0,3507	0,0164	0,1307	0,2064	0,0336	0,0214	0,4743	percentage of total
7,2	5,0	3,0	11,2	14,0	9,0	15,7	7,0	7,5	9,13	9,5	8,0	6,61	mean age
3,49	1,41	0,0	4,57	0,0	0,0	10,07	0,0	1,0	1,6	0,71	0,0	2,29	standard deviation
5	2	1	15	1	1	10	1	4	15	2	1	23	number of subjects

45	46	47	48	49	50	51	
8q	8k	8n	8u	9b	9g	9o	iatttllg
							3 years of age
						0,61	4
1,29	0,32	0,32		0,32	0,32		5
2,31		0,51			0,26		6
1,86		0,23	0,23	0,23			7
1,19	0,3				0,3		8
0,24	0,24						9
0,45							10
0,21							11
							12
							13
							14
							15
							adult
7,5501	0,8601	1,0601	0,2301	0,5501	0,8801	0,6101	totals
0,5393	0,0614	0,0757	0,0164	0,0393	0,0629	0,0436	percentage of total
6,97	7,2	6,0	7,0	6,0	6,33	4,0	mean age
1,55	1,48	0,82	0,0	1,41	1,53	0,0	standard deviation
29	5	4	1	2	3	1	number of subjects

Ap.6:E,2e. Smallest maximum differences of age profiles for cells of all tables drawn from imagination.

column 94 added to column 1 with an sad of 0
column 6 added to column 4 with an sad of 0
column 7 added to column 4 with an sad of 0
column 97 added to column 4 with an sad of 0
column 43 added to column 10 with an sad of 0
column 60 added to column 10 with an sad of 0
column 37 added to column 13 with an sad of 0
column 57 added to column 16 with an sad of 0
column 39 added to column 19 with an sad of 0
column 48 added to column 19 with an sad of 0
column 55 added to column 19 with an sad of 0
column 54 added to column 36 with an sad of 0
column 91 added to column 87 with an sad of 5,879682E-02
column 63 added to column 53 with an sad of 7,072565E-02
column 20 added to column 8 with an sad of 7,295358E-02
column 98 added to column 5 with an sad of 7,627964E-02
column 67 added to column 56 with an sad of 7,917112E-02
column 30 added to column 2 with an sad of 9,066904E-02
column 78 added to column 9 with an sad of 9,069031E-02
column 90 added to column 84 with an sad of 0,1005512
column 95 added to column 58 with an sad of 0,101456
column 66 added to column 41 with an sad of 0,1107266
column 80 added to column 52 with an sad of 0,1107591
column 83 added to column 71 with an sad of 0,1143838
column 76 added to column 49 with an sad of 0,1195219
column 72 added to column 58 with an sad of 0,1195979
column 56 added to column 53 with an sad of 0,1216017
column 53 added to column 52 with an sad of 0,1041095
column 65 added to column 14 with an sad of 0,1278722
column 34 added to column 18 with an sad of 0,1279703
column 52 added to column 45 with an sad of 0,1391379
column 88 added to column 87 with an sad of 0,1393045
column 79 added to column 50 with an sad of 0,1524927
column 81 added to column 75 with an sad of 0,1581764
column 25 added to column 12 with an sad of 0,1594999
column 87 added to column 70 with an sad of 0,1611167
column 77 added to column 14 with an sad of 0,1619294
column 71 added to column 14 with an sad of 0,1268974
column 89 added to column 14 with an sad of 0,1548399
column 23 added to column 11 with an sad of 0,1638376
column 64 added to column 11 with an sad of 0,1358595
column 59 added to column 8 with an sad of 0,1662454
column 18 added to column 17 with an sad of 0,1692716
column 70 added to column 5 with an sad of 0,1699065
column 84 added to column 5 with an sad of 0,1519521
column 49 added to column 44 with an sad of 0,1714013

Appendix 6:E,2e. Continued.

column 47 added to column 44 with an smd of 0,1680412
column 75 added to column 45 with an smd of 0,1783395
column 24 added to column 11 with an smd of 0,1806118
column 42 added to column 41 with an smd of 0,1842105
column 31 added to column 29 with an smd of 0,1876594
column 74 added to column 11 with an smd of 0,1941318
column 58 added to column 12 with an smd of 0,1978041
column 14 added to column 2 with an smd of 0,2019846
column 12 added to column 2 with an smd of 0,2101681
column 45 added to column 28 with an smd of 0,2209436
column 35 added to column 27 with an smd of 0,231848
column 73 added to column 28 with an smd of 0,2333453
column 93 added to column 3 with an smd of 0,2342593
column 41 added to column 2 with an smd of 0,2348722
column 46 added to column 28 with an smd of 0,2362044
column 92 added to column 3 with an smd of 0,2399051
column 44 added to column 28 with an smd of 0,2406566
column 51 added to column 9 with an smd of 0,2413794
column 62 added to column 2 with an smd of 0,2450246
column 32 added to column 11 with an smd of 0,2495625
column 50 added to column 28 with an smd of 0,2500213
column 96 added to column 38 with an smd of 0,2545825
column 33 added to column 9 with an smd of 0,2616544
column 21 added to column 17 with an smd of 0,2726796
column 27 added to column 2 with an smd of 0,2793912
column 82 added to column 28 with an smd of 0,2800669
column 68 added to column 5 with an smd of 0,2834029
column 22 added to column 11 with an smd of 0,2834317
column 28 added to column 26 with an smd of 0,3031753
column 86 added to column 15 with an smd of 0,3134328
column 40 added to column 15 with an smd of 0,2890205
column 61 added to column 5 with an smd of 0,3261238
column 26 added to column 11 with an smd of 0,3377278
column 69 added to column 19 with an smd of 0,3611111
column 19 added to column 11 with an smd of 0,3640621
column 5 added to column 3 with an smd of 0,3730803
column 29 added to column 15 with an smd of 0,3831999
column 15 added to column 10 with an smd of 0,3757455
column 85 added to column 4 with an smd of 0,3888889
column 9 added to column 8 with an smd of 0,3907844
column 2 added to column 1 with an smd of 0,428115
column 11 added to column 10 with an smd of 0,4348718
column 17 added to column 8 with an smd of 0,4656723
column 4 added to column 1 with an smd of 0,4689644
column 3 added to column 1 with an smd of 0,4880892
column 16 added to column 1 with an smd of 0,5121447
column 38 added to column 1 with an smd of 0,5162697
column 36 added to column 1 with an smd of 0,6086247
column 10 added to column 8 with an smd of 0,6543
column 8 added to column 1 with an smd of 0,7443892
column 13 added to column 1 with an smd of 0,5005503

Appendix 6: F

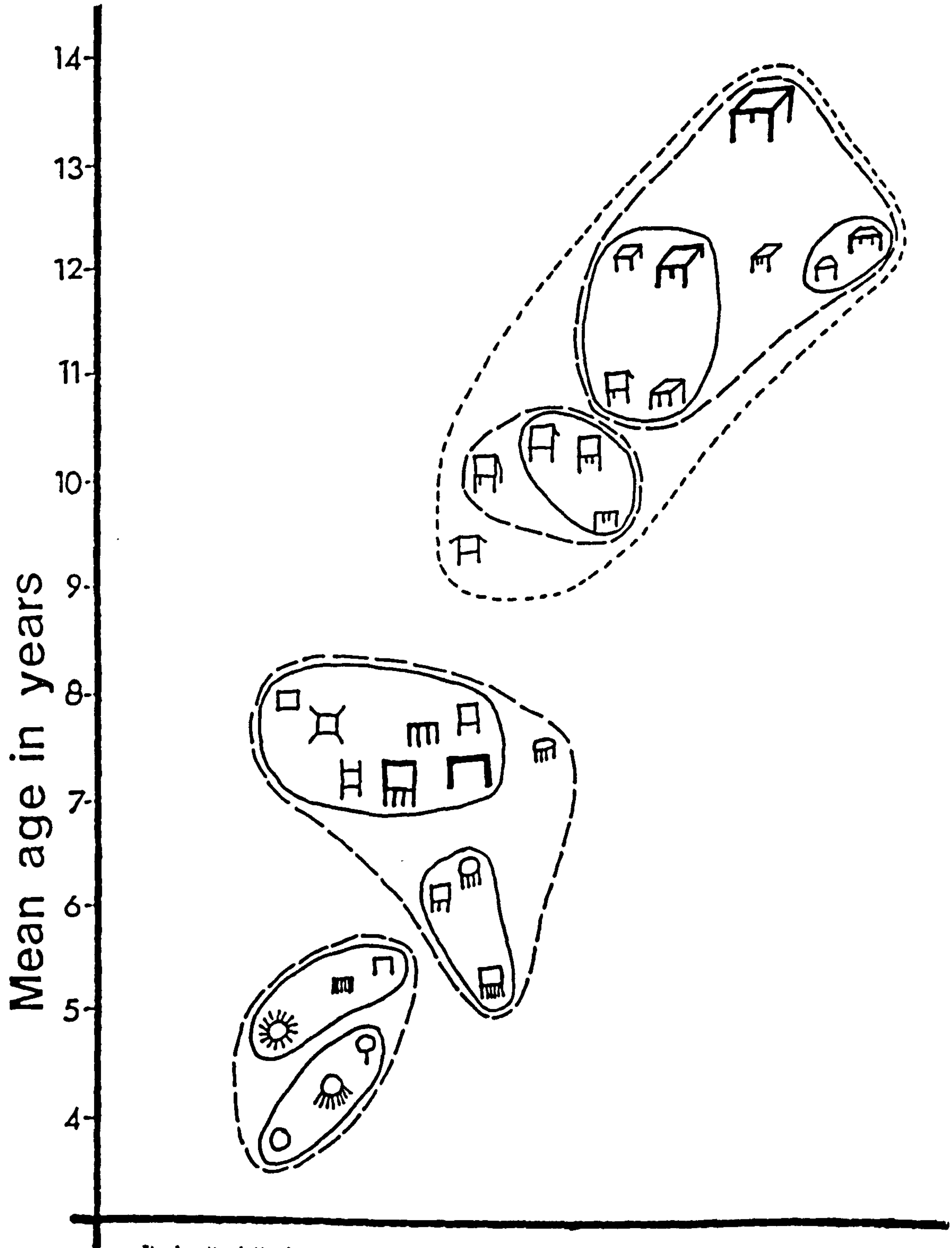
Venn diagrams and dendrograms for tables drawn from observation and imagination, and the information upon which they are based.

This appendix is presented in two sections. It contains an analysis of data by cell type for cells accounting for more than 0.5 percent of all tables drawn from observation and imagination as well as an analysis of all the data. This has been done to enable trends shown in the data to be more easily assimilated. Similarly, each dendrogram has been presented twice. A reduced version has been produced to facilitate an overall view of the data. This is followed by a larger, more readable, version

The dendrograms are constructed by comparing the age profiles for each cell (given in appendices d) using a series of Kolmogorov-Smirnov comparisons. On each pass the two cells with the smallest maximum difference (SMD) are identified and the data in these cells are amalgamated. Appendices e give the series of amlagamations and smd's.

1) Breakdown of data by cell type for cells accounting for more than 0.5 percent of all tables drawn from observation and imagination. Page

Ap.6:F,1a. Venn diagram of cells accounting for more than 0.5 percent of all tables drawn from observation and imagination.



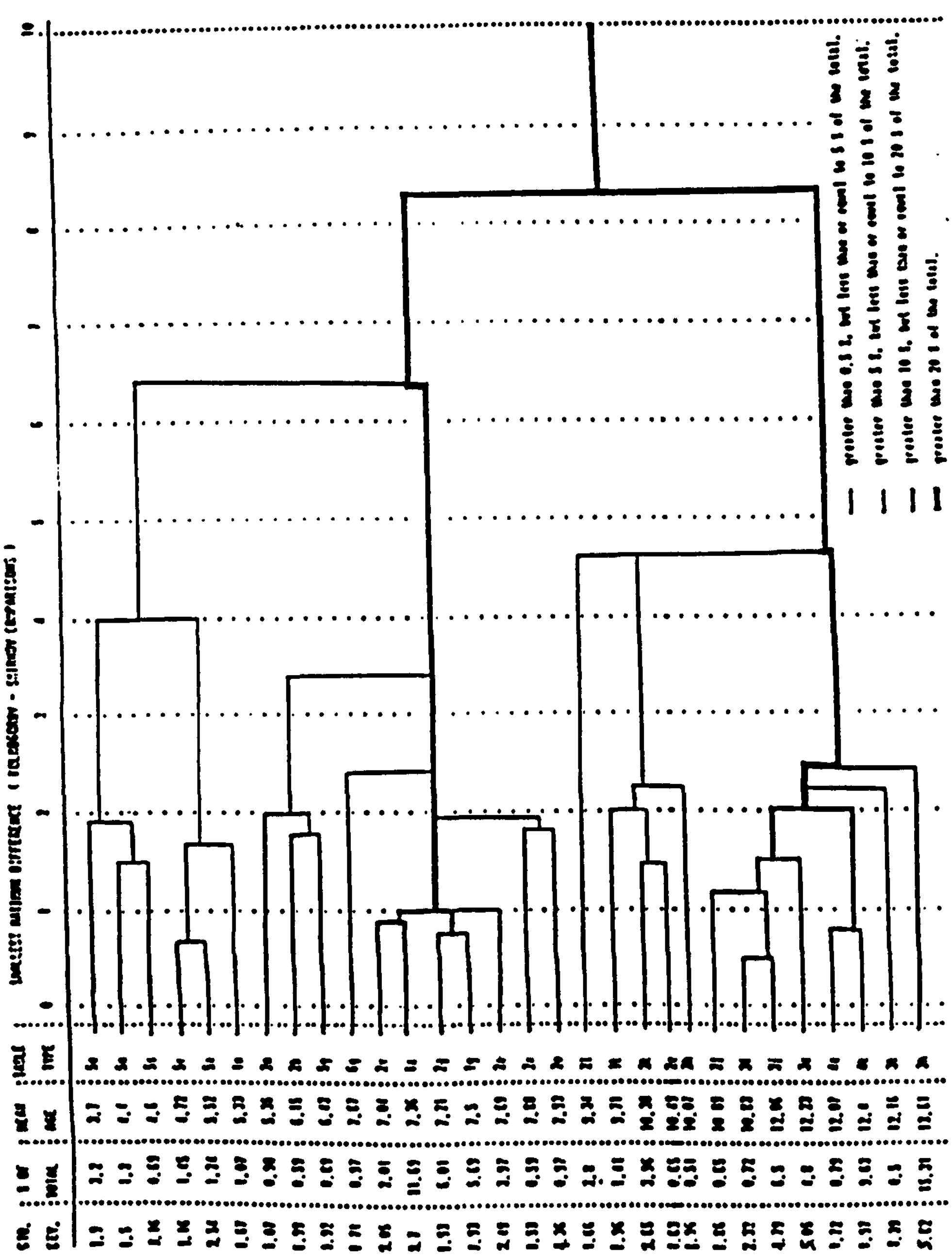
The length of the front line of the table top indicates approximately the percentage of the total accounted for by that table type.

0% to 0.5%
0.5% to 5%
5% to 10%
10% to 20%

The type of enclosure line indicates the smallest maximum difference between age profiles (Kolmogorov - Smirnov comparisons).

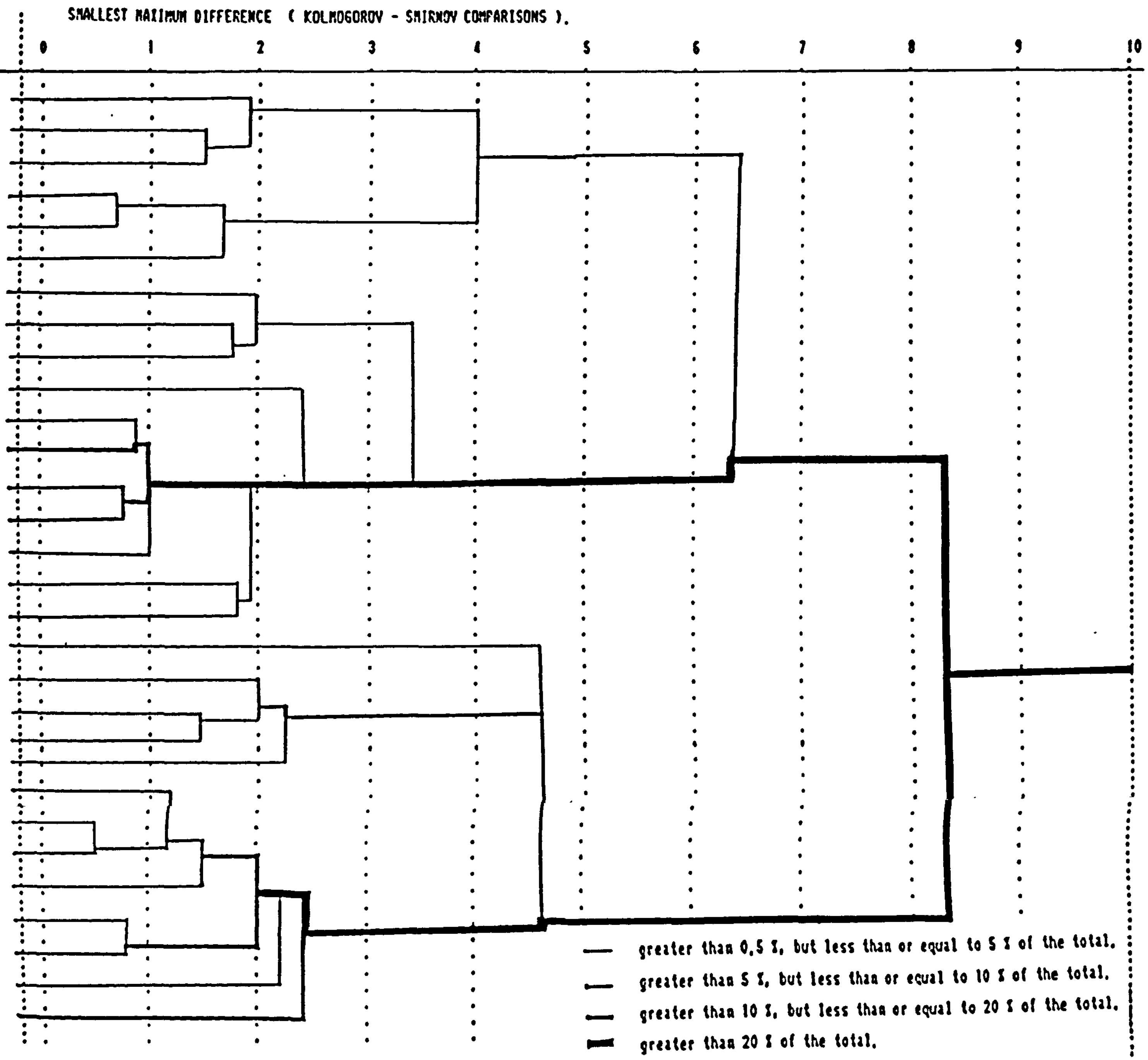
0 to 2
2 to 4
4 to 6
No line, greater than 6.

Ap.6:F,1b. Reduced dendrogram of cells accounting for more than 0.5 percent of all tables drawn from observation and imagination.



Ap.6:F,1c. Dendrogram of cells accounting for more than 0.5 percent of all tables drawn from observation and imagination.

STD. DEV.	% OF TOTAL	MEAN AGE	TABLE TYPE
1,9	3,2	3,7	5o
1,5	1,3	4,4	5n
3,16	0,69	4,6	5s
1,16	1,45	4,72	5r
2,54	1,24	5,52	5a
1,67	1,07	5,33	1n
1,07	0,98	5,35	2n
1,99	0,59	6,15	2b
1,92	0,89	6,43	5g
1 71	0,97	7,67	6g
2,05	2,01	7,04	2v
2.7	11,69	7,36	1a
1,93	6,01	7,21	2g
1,93	5,69	7,5	1g
2,49	3,97	7,69	2a
1,53	0,59	7,88	2x
4,36	0,97	7,93	2o
1,66	2,8	9,34	2l
1,96	1,41	9,71	1k
2,65	3,96	10,38	2k
1,63	0,65	10,49	2e
1,96	0,51	10,07	2h
1,86	0,65	10 89	2j
2,32	0,72	10,83	3f
4,79	6,5	12,06	3j
5,05	4,8	12,23	3e
1,72	0,79	12,07	4a
1,97	9,63	12,4	4k
1,39	0,5	12,16	3k
5,82	15,31	13,61	3h



Ap.6:F,1d. Age profiles for cells accounting for more than 0.5 percent of all tables drawn from observation and imagination.

Column numbers

1	2	3	4	5	6	7	8	9	10	11	12	13
1a	1g	1k	1n	2a	2b	2e	2g	2h	2j	2k	2l	2n
4,44	0		4,44									
28,72	6,15		4,62	10,26	2,56		7,69			0,51		4,62
24,85	9,06		3,8	7,02	2,63		13,74			1,46	0,29	5,26
25,48	15,48	1,43	0,24	6,9	0,95	0,48	17,38	0,24	0,24	1,67	0,48	2,38
23,86	18	1,52	0,87	6,07	0,22		17,14	0,65		2,82	3,47	0,87
17,71	11,17	3	0,54	9,54	1,36	0,27	10,08	0,54	0,82	6,27	4,9	0,54
10,15	9,71	3,31	0,22	4,64	0,44	1,99	8,83	0,66	0,66	7,95	9,71	
6,98	5,07	4,86	0,21	3,81		1,58	5,92	1,06	1,48	8,25	5,71	
4,55	2,11	1,3		1,79		2,6	1,63	1,46	1,46	9,43	2,76	
2,44	2,06	2,63		1,88	0,19	1,13	0,38	0,75	1,13	6,57	1,13	
4,01	0,47	0,94		1,18		0,71	0,71		1,18	6,13	994	
3,47	0,35	0,69		0,69		0,35	0,69		0,35	2,78	0,35	
5,36	0			1,79				1,79	1,79		1,79	
1,57	0									1,57		
163,59	79,63	19,68	14,94	55,57	8,3501	9,1101	84,19	7,1501	9,1101	55,41	1024,6	13,67
11,685	5,6879	1,4057	1,0672	3,9693	0,5964	0,6507	6,0136	0,5107	0,6507	3,9579	73,185	0,9764
7,36	7,5	9,71	5,33	7,69	6,15	10,49	7,21	10,07	10,89	10,38	9,34	5,35
2,7	1,96	1,96	1,67	2,49	1,99	1,63	1,93	1,96	1,86	2,65	1,66	1,07
577	327	90	33	204	27	45	336	28	36	253	137	43

14	15	16	17	18	19	20	21	22	23	24	25	26
2o	2y	2x	3e	3f	3h	3j	3k	4a	4k	5a	5g	5n
2,22	2,22	2,22								8,89	2,22	13,33
2,56	3,08									4,1	2,56	2,05
1,75	5,26	0,29		0,29						2,34	2,05	2,34
0,48	5,24	0,48	0,24		0,24	0,48				0,71	1,67	0,24
1,08	4,77	0,65	0,43		0,43	0,65			0,22		1,52	
2,45	2,72	2,18	1,63	0,27	1,91	2,72		0,27	0,82	0,54	1,09	0
0,88	1,99	2,21	2,87	2,43	5,08	6,18	0,44	0,88	3,53	0,22	1,1	0,22
0,42	1,48	0,21	10,99	1,06	15,22	11,84	0,42		3,81	0,21		
0,33	0,81		7,63	0,81	18,21	13,66	0,81	1,79	16,1			
0,38	0,56		7,69	0,94	21,58	10,32	1,13	1,31	24,2	0,38	0,19	
0,24			6,13	0,71	23,58	10,61	2,83	1,65	32,78			
			9,38	1,04	29,86	6,6	1,39	3,47	35,07			
			10,71	1,79	39,29	16,07		1,79	14,29			
0,79			9,45	0,79	60,63	11,81			3,94			
13,58	28,13	8,2401	67,15	10,13	216,03	90,94	7,0201	11,16	134,76	17,39	12,4	18,18
0,97	2,0093	0,5886	4,7964	0,7236	15,431	6,4957	0,5014	0,7972	9,6257	1,2422	0,8857	1,2986
7,93	7,04	7,88	12,23	10,83	13,61	12,06	12,16	12,07	12,45	5,52	6,43	4,4
4,36	2,05	1,53	5,05	2,32	5,82	4,79	1,39	1,72	1,97	2,54	1,92	1,5
40	103	26	233	36	617	326	31	41	519	29	37	20

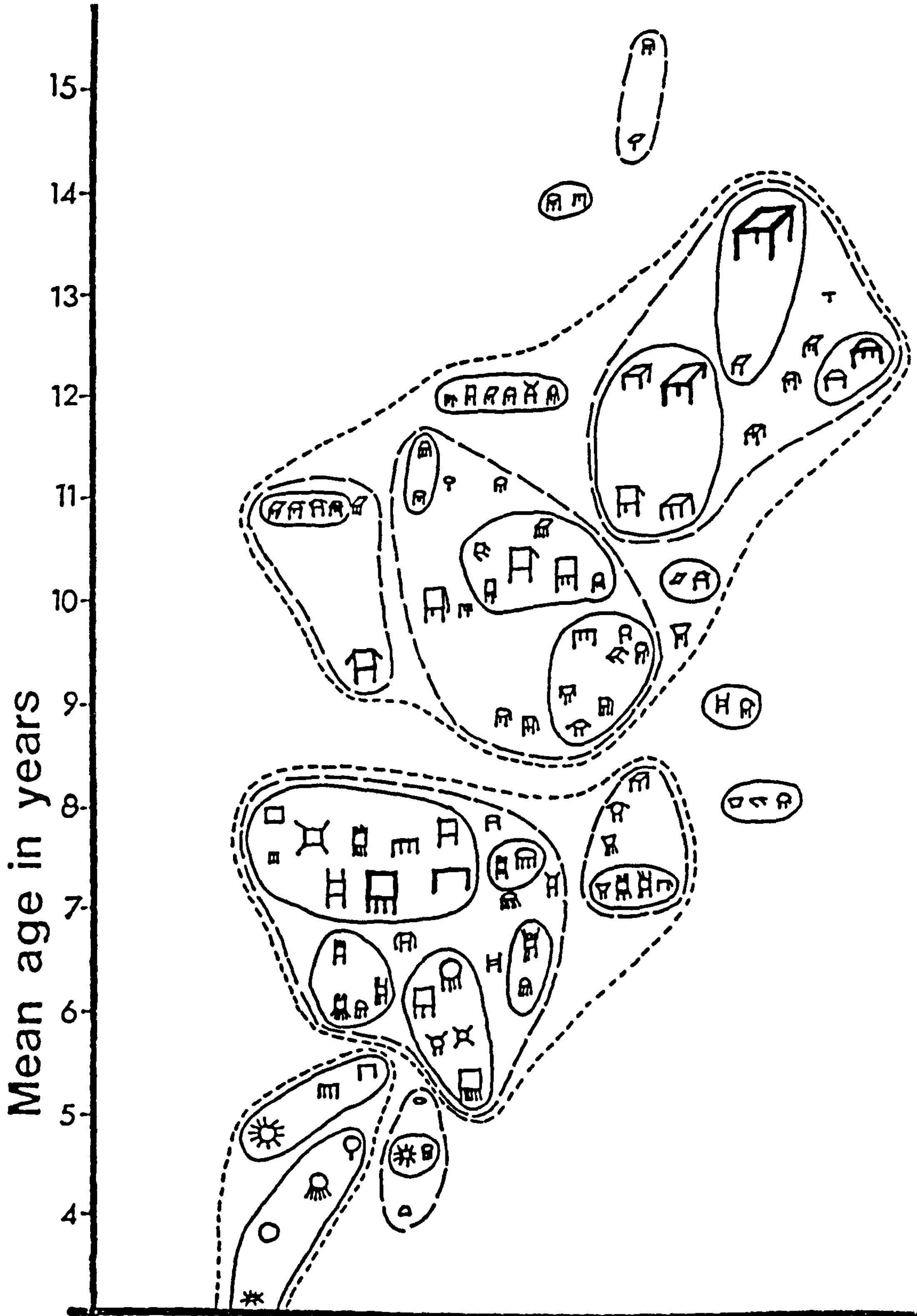
Appendix 6:F,1d. Continued.

27	28	29	30	
5o	5r	5s	6g	obiatotal-small,>0.5
40	8,89	6,67		3 years of age
4,1	5,64			4
0,29	4,09	1,46	0,88	5
	1,19	0,24	3,33	6
0,22	0,22		2,17	7
0	0,27	0,27	4,09	8
0,22		0,22	2,21	9
0,21		0,42		10
		0,16	0,49	11
		0,19	0,19	12
			0,24	13
				14
				15
				adult
45,04	20,3	9,6301	13,6	totals
3,2172	1,45	0,6879	0,9714	percentage of total
3,7	4,72	6,6	7,67	mean age
1,9	1,16	3,16	1,71	standard deviation
30	36	15	57	number of subjects

Ap.6:F,1e. Smallest maximum differences of age profiles for cells accounting for more than 0.5 percent of all tables drawn from observation and imagination.

column 20 added to column 17 with an sad of 6.075954E-02
column 28 added to column 24 with an sad of 7.328233E-02
column 8 added to column 2 with an sad of 7.557362E-02
column 23 added to column 22 with an sad of 8.178461E-02
column 15 added to column 1 with an sad of 8.808625E-02
column 5 added to column 2 with an sad of 0.100149
column 2 added to column 1 with an sad of 0.1118846
column 18 added to column 10 with an sad of 0.1224476
column 11 added to column 7 with an sad of 0.1474148
column 17 added to column 10 with an sad of 0.1486547
column 29 added to column 26 with an sad of 0.1533574
column 24 added to column 4 with an sad of 0.1745543
column 16 added to column 14 with an sad of 0.1762426
column 25 added to column 6 with an sad of 0.1790323
column 27 added to column 26 with an sad of 0.1862493
column 14 added to column 1 with an sad of 0.187283
column 13 added to column 6 with an sad of 0.1913124
column 22 added to column 10 with an sad of 0.2002916
column 7 added to column 3 with an sad of 0.2021356
column 21 added to column 10 with an sad of 0.224068
column 9 added to column 3 with an sad of 0.2317036
column 30 added to column 1 with an sad of 0.2391077
column 19 added to column 10 with an sad of 0.243223
column 6 added to column 1 with an sad of 0.3397269
column 26 added to column 4 with an sad of 0.4014173
column 10 added to column 3 with an sad of 0.460467
column 12 added to column 3 with an sad of 0.4171634
column 4 added to column 1 with an sad of 0.6491983
column 3 added to column 1 with an sad of 0.8378735

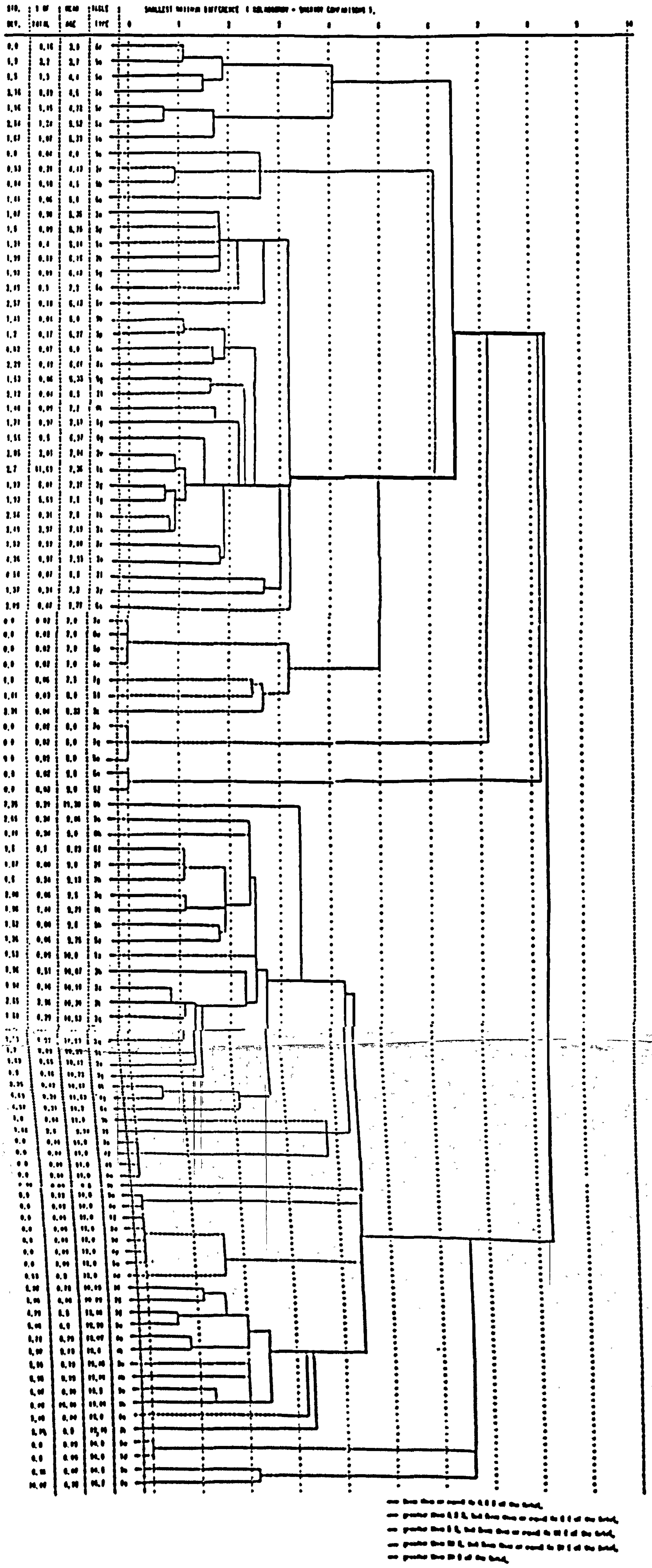
Ap.6:F,2a. Venn diagram of cells of all tables drawn from observation and imagination.



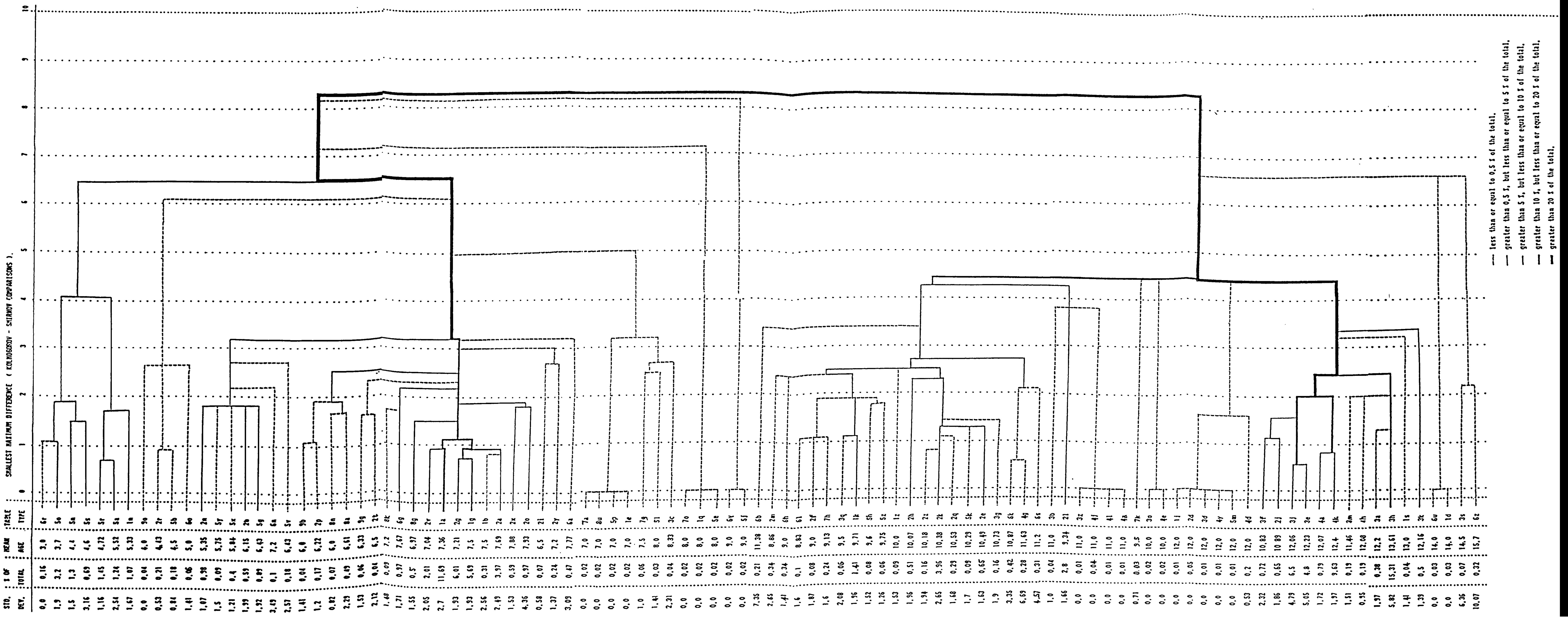
The length of the front line of the table top indicates approximately the percentage of the total accounted for by that table type.
0% to 0.5% — 5% to 10%
0.5% to 5% — 10% to 20%

The type of enclosure line indicates the smallest maximum difference between age profiles (Kolmogorov - Smirnov comparisons).
0 to 2 — 4 to 6
2 to 4 — No line, greater than 6.

Ap.6:F,2b. Reduced dendrogram of cells of all tables drawn from observation and imagination.



Ap.6:F,2c. Dendrogram of cells of all tables drawn from observation and imagination.



Ap.6:F,2d. Age profiles for cells of all tables drawn from observation and imagination.

Column numbers

1	2	3	4	5	6	7	8	9	10	11	12	13
1a	1b	1d	1e	1g	1j	1k	1n	1q	1s	1z	2a	2b
4,44	0			0			4,44					
28,72	0,51			6,15			4,62				10,26	2,56
24,85	0,88			9,06			3,8				7,02	2,63
25,48	0,71			15,48		1,43	0,24				6,9	0,95
23,86	0,22		0,22	18		1,52	0,87			0,22	6,07	0,22
17,71	1,09			11,17		3	0,54	0,27			9,54	1,36
10,15	0,22			9,71		3,31	0,22			0,22	4,64	0,44
6,98	0,21			5,07		4,86	0,21			0,21	3,81	
4,55	0			2,11		1,3				0,65	1,79	
2,44	0.19			2,06	0.19	2,63			0,19		1,88	0,19
4,01	0,24			0,47		0,94					1,18	
3,47	0	0.35		0,35		0,69			0,35		0,69	
5,36	0			0							1,79	
1,57	0			0								
163,59	4,2701	0,3501	0,2201	79,63	0,1901	19,68	14,94	0,2701	0,5401	1,3001	55,57	8,3501
11,685	0,305	0,025	0,0157	5,6879	0,0136	1,4057	1,0672	0,0193	0,0386	0,0929	3,9693	0,5964
7,36	7,5	14,0	7,0	7,5	12,0	9,71	5,33	8,0	13,0	10,0	7,69	6,15
2,7	2,56	0,0	0,0	1,96	0,0	1,96	1,67	0,0	1,41	1,53	2,49	1,99
577	16	1	1	327	1	90	33	1	2	7	204	27

14	15	16	17	18	19	20	21	22	23	24	25	26
2d	2e	2f	2g	2h	2i	2j	2k	2l	2m	2n	2o	2p
											2,22	
			7,69				0,51			4,62	2,56	
			13,74				1,46	0,29	0,58	5,26	1,75	1,17
	0,48	0,24	17,38	0,24	0,48	0,24	1,67	0,48	0,95	2,38	0,48	
			17,14	0,65	0,43		2,82	3,47	0,22	0,87	1,08	0,87
	0,27		10,08	0,54		0,82	6,27	4,9	0,54	0,54	2,45	0,27
	1,99	0,44	8,83	0,66		0,66	7,95	9,71	0,88		0,88	
	1,58	0,21	5,92	1,06		1,48	8,25	5,71	0,42		0,42	
	2,6	0,16	1,63	1,46		1,46	9,43	2,76	0,33		0,33	
0,75	1,13		0,38	0,75		1,13	6,57	1,13	0,19		0,38	
	0,71		0,71			1,18	6,13	0,94	0,71		0,24	
	0,35		0,69			0,35	2,78	0,35				
				1,79		1,79		1,79				
							1,57				0,79	
0,7501	9,1101	1,0501	84,19	7,1501	0,9101	9,1101	55,41	31,53	4,8201	13,67	13,58	2,3101
0,0536	0,6507	0,075	6,0136	0,5107	0,065	0,6507	3,9579	2,2522	0,3443	0,9764	0,97	0,165
12,0	10,49	9,0	7,21	10,07	6,5	10,89	10,38	9,34	8,86	5,35	7,93	6,22
0,0	1,63	1,87	1,93	1,96	0,58	1,86	2,65	1,66	2,65	1,07	4,36	1,2
4	45	5	336	28	4	36	253	137	21	43	40	9

Appendix 6:F,2d. Continued.

27	28	29	30	31	32	33	34	35	36	37	38	39
2q	2r	2t	2v	2x	2y	2z	3a	3b	3c	3d	3e	3f
			2,22	2,22								
	2,05		3,08									
	0,88	0,29	5,26	0,29								0,29
			5,24	0,48	1,19						0,24	
			4,77	0,65	1,3	0,43			0,43		0,43	
0,54		0,27	2,72	2,18	0,54					0	1,63	0,27
0,88			1,99	2,21	0,22	0,22	0,44				2,87	2,43
1,06			1,48	0,21		0,63	0	0,21			10,99	1,06
0,16			0,81		0,16	0,33	0,49	0,16	0,16	0	7,63	0,81
0,75			0,56			0,38	0,94	0,19		0,19	7,69	0,94
0,71						0,24	0,24				6,13	0,71
							0,69				9,38	1,04
							1,79				10,71	1,79
							0,79				9,45	0,79
4,1001	2,9301	0,5601	28,13	8,2401	3,4101	2,2301	5,3801	0,5601	0,5901	0,1901	67,15	10,13
0,2929	0,2093	0,04	2,0093	0,5886	0,2436	0,1593	0,3843	0,04	0,0422	0,0136	4,7964	0,7236
10,53	4,43	6,5	7,04	7,88	7,2	10,18	12,20	11,0	8,33	12,0	12,23	10,83
1,68	0,53	2,12	2,05	1,53	1,37	1,94	1,97	1,0	2,31	0,0	5,05	2,32
19	7	2	103	26	15	11	15	3	3	1	233	36

40	41	42	43	44	45	46	47	48	49	50	51	52
3g	3h	3j	3k	3a	3o	3q	3s	3z	4a	4d	4e	4g
											0	0
											0	0
											0	0
	0,24	0,48									0	0
0,22	0,43	0,65				0,22					0	0,22
	1,91	2,72		0,27					0,27		0	0,54
0,44	5,08	6,18	0,44			0,22			0,88		0	0,66
0,21	15,22	11,84	0,42	0,42	0,21	0,21					0,21	0,42
0,49	18,21	13,66	0,81	0,49				0,16	1,79	0,33	0	0,81
0,56	21,58	10,32	1,13	0,56		0,19			1,31	2,06	0	0,19
	23,58	10,61	2,83	0,94			0,24		1,65	0,47	0	0,24
0,35	29,86	6,6	1,39						3,47		0	0
	39,29	16,07							1,79		0	0
	60,63	11,81					0,79				0	0,79
2,2701	216,03	90,94	7,0201	2,6801	0,2101	0,8401	1,0301	0,1601	11,16	2,8601	0,2101	3,8701
0,1622	15,431	6,4957	0,5014	0,1914	0,015	0,06	0,0736	0,0114	0,7972	0,2043	0,015	0,2764
10,73	13,61	12,06	12,16	11,46	10,0	9,5	14,5	11,0	12,07	12,0	10,0	11,63
1,9	5,82	4,79	1,39	1,51	0,0	2,08	6,36	0,0	1,72	0,53	0,0	6,69
11	617	326	31	13	1	4	2	1	41	15	1	16

Appendix 6:F,2d. Continued.

53	54	55	56	57	58	59	60	61	62	63	64	65
4h	4j	4k	4l	4a	4y	5a	5b	5e	5g	5h	5j	5k
						8,89			2,22			
						4,1	2,05		2,56			
						2,34	0,29		2,05			
						0,71	0,24		1,67			
		0,22							1,52			0,22
		0,82				0,54		0,27	1,09	0,54		
		3,53				0,22			1,1		0,22	0,22
		3,81				0,21				0,21		
0,65	0,49	16,1	0,16	0,16	0,16					0,33		0,65
0,94		24,2				0,38			0,19			0,19
0,71		32,78										
0,35		35,07										
		14,29										
		3,94										
2,6501	0,4901	134,76	0,1601	0,1601	0,1601	17,39	2,5801	0,2701	12,4	1,0801	0,2201	1,2801
0,1893	0,035	9,6257	0,0114	0,0114	0,0114	1,2422	0,1843	0,0193	0,8857	0,0772	0,0157	0,0914
12,08	11,0	12,45	11,0	11,0	11,0	5,52	4,5	8,0	6,43	9,60	9,0	10,29
0,95	0,0	1,97	0,0	0,0	0,0	2,54	0,84	0,0	1,92	1,52	0,0	1,7
5	3	519	1	1	1	29	6	1	37	5	1	7

66	67	68	69	70	71	72	73	74	75	76	77	78
5l	5m	5n	5o	5p	5r	5s	5v	5x	5y	5z	6a	6b
		13,33	40		8,89	6,67					2,22	
		2,05	4,1		5,64		1,54	2,05	0,51			0,51
		2,34	0,29		4,09	1,46		0,58	0,29		0,29	
		0,24			1,19	0,24	0,24	1,67			0,95	
0,22			0,22	0,22	0,22			1,08	0,43		0,22	
		0	0		0,27	0,27	0,27	0,27		0,27	0,27	0,82
0,22		0,22	0,22			0,22	0,22				0,44	0,22
			0,21			0,42	0,21			0,42	0,21	
						0,16				0,16	0,16	
	0,19					0,19						0,19
												0,35
											1,79	
												0,79
0,4401	0,1901	18,18	45,04	0,2201	20,3	9,6301	2,4801	5,6501	1,2301	0,8501	6,5501	2,8801
0,0314	0,0136	1,2986	3,2172	0,0157	1,45	0,6879	0,1772	0,4036	0,0879	0,0607	0,4679	0,2057
8,0	12,0	4,4	3,7	7,0	4,72	6,6	6,43	5,84	5,75	9,75	7,77	11,38
1,41	0,0	1,5	1,9	0,0	1,16	3,16	2,57	1,21	1,5	1,26	3,09	7,35
2	1	20	30	1	36	15	7	19	4	4	13	8

Appendix 6:F,2d. Continued.

	79	80	81	82	83	84	85	86	87	88	89	90	91
obiatotal-large	6g	6h	6k	6l	6n	6o	6r	6s	6u	6v	6z	7a	7g
3 years of age							2,22						
4					0,51	0,61							
5	0,88				0,58								
6	3,33			0,24		0,26		0,24					
7	2,17		0,22					0,22				0,22	0,65
8	4,09	0,27	0,54	0,27				0,54			0,27		0
9	2,21		1,32	0,22				0,44		0,22	0,22		0,22
10		0,21	0,63	0,63				0,21					
11	0,49		1,14		0,33			0,33			0,33		
12	0,19		0,19					0,75			0,19		
13	0,24		0,24										
14									0,35		0,35		
15													
adult			1,57					1,57			3,15		
totals	13,6	0,4801	5,8501	1,3601	1,4201	0,8701	2,2201	4,3001	0,3501	0,2201	4,5101	0,2201	0,8701
percentage of total	0,9714	0,0343	0,4179	0,0972	0,1014	0,0622	0,1586	0,3072	0,025	0,0157	0,3222	0,0157	0,0622
mean age	7,67	9,0	10,87	8,83	7,2	5,0	3,0	11,2	14,0	9,0	15,7	7,0	7,5
standard deviation	1,71	1,41	3,35	1,6	3,49	1,41	0,0	4,57	0,0	0,0	10,07	0,0	1,0
number of subjects	57	2	23	6	5	2	1	15	1	1	10	1	4

	92	93	94	95	96	97	98	99	100	101	102
obiatotal-large	7h	7k	7o	8a	8g	8k	8n	8u	9b	9g	9o
3 years of age											
4											0,51
5	0,29			2,34	1,17	0,29	0,29		0,29	0,29	
6				1,9	2,14		0,48			0,24	
7				1,65	1,74	0,43	0,22	0,22	0,22		
8	0,82		0,27	0,27	1,09	0,27				0,27	
9	1,1	0,22		0,22	0,22	0,22					
10	0,85	0,21			0,42						
11	0,16				0,16						
12	0,19			0,19							
13											
14				0,35							
15											
adult											
totals	3,4101	0,4301	0,2701	6,9201	6,9401	1,2101	0,9901	0,2201	0,5101	0,8001	0,5101
percentage of total	0,2436	0,0307	0,0193	0,4943	0,4957	0,0864	0,0707	0,0157	0,0364	0,0572	0,0364
mean age	9,13	9,5	8,0	6,61	6,97	7,2	6,0	7,0	6,0	6,33	4,0
standard deviation	1,6	0,71	0,0	2,29	1,55	1,48	0,82	0,0	1,41	1,53	0,0
number of subjects	15	2	1	23	29	5	4	1	2	3	1

Ap.6:F,2e. Smallest maximum differences of age profiles for cells of all tables drawn from observation and imagination.

```
column 86 added to column 3 with an sad of 0
column 69 added to column 4 with an sad of 0
column 89 added to column 4 with an sad of 0
column 98 added to column 4 with an sad of 0
column 14 added to column 6 with an sad of 0
column 37 added to column 6 with an sad of 0
column 66 added to column 6 with an sad of 0
column 60 added to column 9 with an sad of 0
column 93 added to column 9 with an sad of 0
column 51 added to column 45 with an sad of 0
column 54 added to column 48 with an sad of 0
column 56 added to column 48 with an sad of 0
column 57 added to column 48 with an sad of 0
column 87 added to column 63 with an sad of 0
column 42 added to column 38 with an sad of 6,075954E-02
column 80 added to column 52 with an sad of 6,646791E-02
column 70 added to column 58 with an sad of 7,328233E-02
column 17 added to column 5 with an sad of 7,557362E-02
column 33 added to column 21 with an sad of 8,173802E-02
column 55 added to column 49 with an sad of 8,178461E-02
column 12 added to column 2 with an sad of 8,256102E-02
column 30 added to column 1 with an sad of 8,808625E-02
column 59 added to column 28 with an sad of 9,491497E-02
column 5 added to column 2 with an sad of 9,549698E-02
column 2 added to column 1 with an sad of 0,1103619
column 91 added to column 81 with an sad of 0,1113291
column 84 added to column 68 with an sad of 0,1119006
column 46 added to column 7 with an sad of 0,1120064
column 99 added to column 26 with an sad of 0,1168831
column 81 added to column 16 with an sad of 0,1174603
column 27 added to column 21 with an sad of 0,119535
column 39 added to column 20 with an sad of 0,1224476
column 64 added to column 15 with an sad of 0,1304542
column 21 added to column 15 with an sad of 0,1285393
column 41 added to column 34 with an sad of 0,1338153
column 40 added to column 15 with an sad of 0,1359415
column 38 added to column 20 with an sad of 0,1486547
column 95 added to column 1 with an sad of 0,1518369
column 71 added to column 67 with an sad of 0,1533574
column 100 added to column 29 with an sad of 0,1553572
column 58 added to column 6 with an sad of 0,1643356
column 97 added to column 94 with an sad of 0,165061
column 58 added to column 8 with an sad of 0,1745543
column 96 added to column 78 with an sad of 0,1749635
column 31 added to column 25 with an sad of 0,1762426
column 61 added to column 13 with an sad of 0,1790323
column 73 added to column 13 with an sad of 0,1628149
column 74 added to column 13 with an sad of 0,1757575
```

Appendix 6:F,2e. Continued.

```
column  75 added to column  62 with an sad of  0,1823529
column  24 added to column  13 with an sad of  0,1824137
column  94 added to column  26 with an sad of  0,1852399
column  68 added to column  67 with an sad of  0,1872298
column  25 added to column  1 with an sad of  0,187713
column  16 added to column  7 with an sad of  0,1925855
column  62 added to column  7 with an sad of  0,176158
column  49 added to column  20 with an sad of  0,2002916
column  53 added to column  43 with an sad of  0,2011396
column  44 added to column  43 with an sad of  0,2003812
column  85 added to column  52 with an sad of  0,2082591
column  78 added to column  1 with an sad of  0,2229086
column  82 added to column  13 with an sad of  0,2231934
column  88 added to column  47 with an sad of  0,2239468
column  18 added to column  15 with an sad of  0,2292476
column  29 added to column  1 with an sad of  0,2343392
column  34 added to column  20 with an sad of  0,2388741
column  23 added to column  7 with an sad of  0,2396064
column  79 added to column  7 with an sad of  0,2411605
column  90 added to column  65 with an sad of  0,2471264
column  26 added to column  1 with an sad of  0,2492033
column  15 added to column  7 with an sad of  0,2537653
column  83 added to column  28 with an sad of  0,2552934
column  101 added to column  28 with an sad of  0,2617555
column  11 added to column  7 with an sad of  0,2649409
column  52 added to column  7 with an sad of  0,2668282
column  72 added to column  13 with an sad of  0,2691419
column  32 added to column  19 with an sad of  0,2697948
column  65 added to column  36 with an sad of  0,2711864
column  19 added to column  1 with an sad of  0,2970661
column  77 added to column  7 with an sad of  0,3079769
column  76 added to column  1 with an sad of  0,3155806
column  36 added to column  4 with an sad of  0,3157895
column  20 added to column  10 with an sad of  0,3211728
column  13 added to column  1 with an sad of  0,3230102
column  43 added to column  10 with an sad of  0,33919
column  48 added to column  35 with an sad of  0,375
column  67 added to column  8 with an sad of  0,4066336
column  35 added to column  7 with an sad of  0,4287518
column  45 added to column  7 with an sad of  0,4388579
column  92 added to column  7 with an sad of  0,4374953
column  10 added to column  7 with an sad of  0,4689219
column  7 added to column  6 with an sad of  0,4174697
column  22 added to column  6 with an sad of  0,444825
column  4 added to column  1 with an sad of  0,4935782
column  28 added to column  1 with an sad of  0,6058549
column  8 added to column  1 with an sad of  0,6465807
column  47 added to column  6 with an sad of  0,6567785
column  9 added to column  1 with an sad of  0,7187575
column  63 added to column  1 with an sad of  0,8234605
column  6 added to column  1 with an sad of  0,8298217
column  3 added to column  1 with an sad of  0,8749169
```

Appendix 6: G.

Analysis of depth cue by projection system.

This appendix has three parts. In the first part the amalgamated data are grouped according to system of projection used on the table top and combination of depth cues used on the table legs, as identified in Table 2. The percentage of total data, summed across age, number of subjects, mean age and standard deviation of age are given for each cell. The second and third parts give progressively shortened versions of this table.

Ap.6:Ga. Form of projection (types 1 to 9) by combinations of depth cue usage as classified in Table 2.

DESCRIPTION OF DEPTH CUE CLASSIFICATION		FORM OF PROJECTION ON TABLE TOP 1	2	3	4	5	6	7	8	9	TOTAL
A	%		1.0	0		1.4	0.1	0		0	2.5
	S	0	47.0	1.0	0	66.0	3.0	1.0	0	1.0	119.0
H1, 01	MA		7.4	10.0		4.26	4.33	8.0		4.0	5.58
	SD		4.22	0		1.61	1.53	0		0	3.31
B	%		0.2			0					0.3
	S	0	11.0	0	0	1.0	0	0	0	0	12.0
H2, 01	MA		6.27			7.0					6.33
multiple legs	SD		1.27			0					1.23
C	%		3.0		0	0.6	0				3.7
	S	0	144.0	0	1.0	30.0	1.0	0	0	0	176.0
H2, 01	MA		7.21		12.0	5.97	9.0				7.03
	SD		1.92		0	1.61	0				1.96
D	%	0.7	0.9			0.4	0.1		0.1		2.2
	S	33.0	43.0	0	0	20.0	5.0	0	4.0	0	105.0
H3, 01	MA	5.33	5.35			4.4	7.2		6.0		5.28
multiple legs	SD	1.67	1.07			1.5	3.49		0.82		1.6
E	%	19.2	11.8	0.6	1.2	1.8	1.9	0.1	1.1	1.1	37.9
	S	922.0	567.0	31.0	57.0	87.0	93.0	5.0	52.0	5.0	1819.0
H3, 01	MA	7.43	7.33	11.9	11.95	6.02	8.57	7.4	6.81	6.2	7.59
legs from front	SD	2.47	2.17	2.68	3.76	2.39	3.57	0.89	1.9	1.3	2.7
F	%		0.1	0.1							0.1
	S	0	4.0	3.0	0	0	0	0	0	0	7.0
H3, 01	MA		6.5	8.33							7.29
legs from back	SD		0.58	2.31							1.7
G	%		0.1	0.8							0.9
	S	0	5.0	36.0	0	0	0	0	0	0	41.0
H3, 03	MA		9.0	10.83							10.61
	SD		1.87	2.32							2.33
H	%	0.2	4.9	5.2	0.1	0.2	0.3				10.8
	S	9.0	233.0	251.0	3.0	8.0	16.0	0	0	0	520.0
H4, 01	MA	9.44	9.65	12.14	10.67	9.38	13.13				10.96
	SD	1.74	1.85	4.9	0.58	1.69	0.57				4.12
I	%		0.4	0.3	0.2	0.2					41.7
	S	0	21.0	13.0	1.0	1.0	0	0	0	0	36.0
H4,02	MA		8.9	11.0	11.0	12.0					12.20
	SD		2.7	1.5	0.0	0.0					4.26
J	%	1.9	6.7	20.3	11.5	0.3	0.5	0.4	0.1		41.7
	S	92.0	321.0	975.0	550.0	13.0	26.0	17.0	6.0	0	2000.0
H4, 03	MA	9.78	10.43	13.04	12.42	9.92	10.85	9.18	7.17		12.20
	SD	2.0	2.51	5.45	1.92	1.55	3.26	1.51	1.33		4.26
TOTAL	%	22.0	28.7	27.0	12.7	4.7	3.0	0.5	1.3	0.1	
	S	1056.0	1375.0	1297.0	611.0	225.0	144.0	23.0	62.0	6.0	4799.0
	MA	7.58	8.37	12.77	12.36	5.7	9.35	8.74	6.79	5.83	
	SD	2.53	2.69	5.25	2.16	2.45	4.61	1.54	1.8	1.47	

Ap.6:Gb. Form of projection (types 1 to 9) by use of depth cue.

DESCRIPTION		FORM OF PROJECTION ON TABLE TOP 1	2	3	4	5	6	7	8	9	TOTAL
	%		4,2	0,0	0,0	2,0	0,1	0,0		0,0	6,4
NO	S	0	202,0	1,0	1,0	97,0	4,0	1,0	0	1,0	307,0
GROUND	MA		7,2	10,0	12,0	4,81	5,5	8,0		4,0	6,44
LINE	SD		2,61	0,0	0,0	1,79	2,65	0,0		0,0	2,64
	%	19,9	12,9	1,5	1,2	2,2	2,0	0,1	1,2	0,1	41,1
	S	955,0	619,0	70,0	57,0	107,0	98,0	5,0	56,0	5,0	1972,0
GROUND	MA	7,35	7,2	11,2	11,95	5,72	8,5	7,4	6,75	6,2	7,52
LINE	SD	2,48	2,17	2,58	3,76	2,33	3,56	0,89	1,85	1,3	2,73
	%	2,1	11,5	25,5	11,5	0,4	0,9	0,4	0,1		52,5
	S	101,0	554,0	1226,0	553,0	21,0	42,0	17,0	6,0	0,0	2520,0
GROUND	MA	9,75	10,1	12,86	12,41	9,71	11,71	9,18	7,17		11,94
PLANE	SD	1,98	2,29	5,35	1,92	1,59	5,88	1,51	1,33		4,26
	%	20,1	21,9	6,0	1,3	4,4	2,5	0,1	1,2	0,1	57,5
NO	S	964,0	1049,0	286,0	61,0	212,0	118,0	6,0	56,0	6,0	2758,0
OCCLU-	MA	7,37	7,74	12,07	11,89	5,44	9,03	7,5	6,75	5,83	8,01
SION	SD	2,48	2,42	4,69	3,65	2,26	4,8	0,84	1,85	1,47	3,34
	%	1,9	6,8	21,1	11,5	0,3	0,5	0,4	0,1		42,5
PARTIAL	S	92,0	326,0	1011,0	550,0	13,0	26,0	17,0	6,0	0	2041,0
OCCLU-	MA	9,78	10,41	12,96	12,42	9,92	10,85	9,18	7,17		12,17
SION	SD	2,0	2,5	5,38	1,92	1,55	3,26	1,51	1,33		4,24
	%	22,0	28,3	27,0	12,7	4,7	3,0	0,5	1,3	0,1	
TOTAL	S	1056,0	1375,0	1297,0	611,0	225,0	114,0	23,0	62,0	6,0	4799,0
	MA	7,58	8,37	12,77	12,36	5,7	9,35	8,74	6,79	5,83	
	SD	2,53	2,69	5,25	2,16	2,45	4,61	1,54	1,8	1,47	

Ap.6:Gc. Form of projection (types 1 to 4) by use of depth cue.

DESCRIPTION		FORM OF PROJECTION ON TABLE TOP 1	2	3	4	TOTAL
	%		6,3	0,0	0,1	6,4
NO	S	0	300,0	2,0	5,0	307,0
GROUND	MA		6,43	7,0	6,8	6,44
LINE	SD		2,62	4,24	3,7	2,64
	%	19,9	16,4	1,6	3,2	41,1
	S	955,0	787,0	75,0	155,0	1972,0
GROUND	MA	7,35	6,97	10,87	9,77	7,52
LINE	SD	2,48	2,22	2,81	3,99	2,73
	%	2,6	12,5	25,5	12,4	52,5
	S	101,0	598,0	1226,0	595,0	2520,0
GROUND	MA	9,75	10,03	12,86	12,36	11,94
PLANE	SD	1,98	2,26	5,35	2,42	4,26
	%	20,1	27,6	6,1	4,1	57,5
NO	S	964,0	1323,0	292,0	197,0	2758,0
OCCLU-	MA	7,37	7,33	11,94	10,0	8,01
SION	SD	2,48	2,52	4,73	4,63	3,34
	%	1,9	7,5	21,1	12,0	42,5
PARTIAL	S	92,0	362,0	1011,0	576,0	2041,0
OCCLU-	MA	9,78	10,28	12,96	12,35	12,17
SION	SD	2,0	2,47	5,38	2,03	4,24
	%	22,0	35,1	27,2	15,7	
TOTAL	S	1056,0	1683,0	1303,0	755,0	4799,0
	MA	7,58	7,96	12,73	11,79	
	SD	2,53	2,78	5,26	3,03	

APPENDICES TO CHAPTER 7.

Preference in representation of tables.

Appendix 7:A. Data for Study 7:1.

RAW DATA for MOST LIKE question.

Age / Stimulus	2	3	4	5	6	7	8	9	10	11	12	13	14	15	adult	total
1	0.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
2	0.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00
3	0.00	1.00	4.00	1.00	2.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	11.00
4	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00
5	0.00	2.00	1.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00
6	0.00	0.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00
7	9.00	11.00	11.00	4.00	5.00	11.00	8.00	11.00	13.00	32.00	20.00	17.00	23.00	21.00	16.00	212.00
8	1.00	2.00	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	6.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	1.00	2.00	1.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00
11	2.00	2.00	1.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00
12	0.00	0.00	1.00	2.00	2.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00
13	0.00	0.00	4.00	2.00	0.00	3.00	4.00	3.00	1.00	3.00	6.00	4.00	6.00	3.00	5.00	44.00
14	5.00	6.00	7.00	12.00	13.00	11.00	14.00	12.00	13.00	4.00	2.00	6.00	0.00	1.00	3.00	109.00
15	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00
16	2.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00
totals	21.00	28.00	34.00	28.00	27.00	29.00	28.00	26.00	28.00	39.00	28.00	27.00	29.00	27.00	25.00	424.00

RAW DATA for BEST PICTURE question.

Age / Stimulus	2	3	4	5	6	7	8	9	10	11	12	13	14	15	adult	total
1	0.00	0.00	1.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
2	0.00	2.00	0.00	0.00	1.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00
3	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00
4	0.00	0.00	3.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00
5	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00
6	1.00	3.00	8.00	3.00	6.00	2.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	25.00
7	1.00	3.00	5.00	3.00	7.00	6.00	7.00	12.00	14.00	15.00	15.00	12.00	20.00	18.00	16.00	154.00
8	1.00	1.00	0.00	2.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00
9	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00
10	2.00	3.00	2.00	1.00	2.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.00
11	1.00	2.00	1.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00
12	0.00	5.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	8.00
13	2.00	1.00	2.00	0.00	3.00	7.00	8.00	8.00	6.00	13.00	6.00	6.00	1.00	5.00	6.00	74.00
14	1.00	2.00	3.00	9.00	2.00	4.00	12.00	5.00	7.00	11.00	4.00	8.00	8.00	3.00	3.00	82.00
15	3.00	3.00	1.00	2.00	1.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	11.00
16	0.00	1.00	0.00	2.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00
totals	13.00	27.00	28.00	28.00	27.00	29.00	28.00	26.00	28.00	39.00	26.00	26.00	29.00	26.00	27.00	407.00

Appendix 7:B. Data for Study 7:2.

Raw data for shaded and non-shaded conditions.

SHADED STIMULI.

Age / Stimulus.	4	5	6	7	8	9	10	Total.
1	3	2	4	4	6	6	5	30
2	0	2	1	2	0	0	0	5
3	3	0	0	0	0	0	0	3
4	2	2	2	0	0	0	0	6
5	3	6	2	3	5	3	4	26
6	2	1	2	0	0	0	0	5
7	0	0	1	1	0	1	0	3
8	2	2	3	5	4	5	6	27
total	15	15	15	15	15	15	15	105.

NON-SHADED STIMULI.

Age / Stimulus.	4	5	6	7	8	9	10	Total.
1	1	2	2	9	6	4	4	28
2	1	0	1	0	2	0	1	5
3	3	3	1	0	0	0	0	7
4	2	3	0	0	0	0	0	5
5	2	3	3	3	1	5	4	21
6	1	0	0	0	1	0	0	2
7	2	2	0	0	0	0	0	4
8	3	2	8	3	5	6	6	33
total	15	15	15	15	15	15	15	105.

Appendix 7:C. Data for Study 7:3.

RAW DATA FOR CHOICE OF TABLE WITH BACKGROUND IN PERSPECTIVE.

Age	4	5	6	7	8	9	10	11	12	13	14	Total
Stimulus												
1a	5	3	4	0	1	1	1	0	1	0	0	16
2a	2	2	3	0	0	1	0	0	1	0	0	9
3h	16	11	11	14	15	17	14	43	41	33	12	227
3j	2	9	6	9	6	7	10	0	0	0	0	49
4k	0	3	6	4	4	4	3	0	0	1	3	28
4k(naive)	7	4	2	5	6	2	4	9	15	19	15	88
Totals	32	32	32	32	32	32	32	52	58	53	30	417
Tops												
1	5	3	4	0	1	1	1	0	1	0	0	16
2	2	2	3	0	0	1	0	0	1	0	0	9
3	18	20	17	23	21	24	24	43	41	33	12	276
4	7	7	8	9	10	6	7	9	15	20	18	116

RAW DATA FOR CHOICE OF TABLE WITH BLANK BACKGROUND

Age	4	5	6	7	8	9	10	11	12	13	14	Total
Stimulus												
1a	5	1	4	0	0	0	0	0	0	0	0	13
2a	1	0	0	1	0	0	1	0	0	0	0	3
3h	15	15	13	17	16	21	18	43	52	37	21	268
3j	5	6	7	6	10	5	11	0	0	0	0	50
4k	2	4	5	4	3	4	2	0	1	4	2	31
4k(naive)	4	6	3	4	3	2	0	6	5	11	10	54
Totals	32	32	32	32	32	32	32	49	58	52	33	416
Tops												
1	5	1	4	0	0	0	0	0	0	0	0	13
2	1	0	0	1	0	0	1	0	0	0	0	3
3	20	21	20	23	26	26	29	43	52	37	21	318
4	6	10	8	8	6	6	2	6	6	15	12	85

Appendix 7:D. Data for Study 7:4.

RAW DATA FOR CHOICE WHILST LOOKING AT A REAL TABLE

CONDITION A) VIEW STIMULUS BEFORE TABLE.

Age. / Stim.	4	5	6	7	8	9	10	11	12	13	14	Adult	Total.
1 (3f)	1	1	0	0	1	0	0	0	0	0	0	1	4
2 (4a)	0	1	1	0	0	0	1	1	1	1	4	1	11
3 (3jr)	1	1	2	2	2	2	0	2	1	0	1	0	14
4 (2g)	0	0	0	0	0	0	1	0	0	0	0	0	1
5 (2i)	0	0	0	0	0	0	0	0	0	0	0	0	0
6 (3hl)	3	6	3	5	1	4	3	2	4	4	2	3	40
7 (4g)	0	0	0	0	0	0	0	0	0	0	0	1	1
8 (2f)	0	0	0	0	1	0	0	0	0	0	0	0	1
9 (2a)	0	0	1	1	0	0	1	2	0	2	1	2	10
10 (5x)	0	0	0	0	0	0	0	0	0	0	0	0	0
11 (2h)	1	0	0	0	0	0	0	0	0	0	0	0	1
12 (3jl)	1	1	2	2	1	2	1	1	1	1	0	0	13
13 (2l)	0	0	0	0	0	0	0	0	0	0	0	0	0
14 (1k)	0	0	0	1	0	0	0	1	1	0	0	0	3
15 (3hr)	6	3	3	5	5	8	6	2	4	3	3	3	51
16 (4t)	1	1	0	0	1	0	0	4	4	4	5	5	25
17 (3e)	1	2	3	0	3	0	2	1	0	1	0	0	13
18 (2v)	0	0	0	0	0	0	0	0	0	0	0	0	0
19 (1a)	0	0	1	0	1	0	1	0	0	0	0	0	3
20 (5g)	1	0	0	0	0	0	0	0	0	0	0	0	1

CONDITION B), VIEW TABLE BEFORE STIMULUS.

Age / Stim.	4	5	6	7	8	9	10	11	12	13	14	Adult	Total.
1 (3f)	0	1	4	1	3	0	0	0	0	0	0	0	9
2 (4a)	1	2	2	1	1	2	1	1	1	3	1	2	18
3 (3jr)	3	1	0	1	1	3	3	2	0	0	1	1	16
4 (2g)	0	0	0	0	0	0	0	0	0	0	0	0	0
5 (2i)	0	0	0	0	1	0	0	0	0	0	0	0	1
6 (3hl)	3	3	6	4	2	2	0	2	6	3	5	6	42
7 (4g)	0	0	0	0	0	0	1	0	1	0	0	0	2
8 (2f)	0	0	0	0	2	0	0	0	0	0	0	0	2
9 (2a)	1	0	0	1	0	0	1	0	1	0	1	2	7
10 (5v)	0	0	0	0	0	0	0	0	0	0	0	0	0
11 (2h)	0	0	0	0	0	0	0	0	0	0	0	0	0
12 (3jl)	2	1	1	4	2	3	4	4	1	0	1	0	23
13 (2l)	0	0	0	0	0	0	1	0	0	0	0	0	1
14 (1k)	0	0	0	0	0	1	0	1	0	0	1	1	4
15 (3hr)	5	5	3	2	3	4	2	3	2	3	1	1	34
16 (4t)	0	0	0	0	0	0	2	2	3	5	5	3	20
17 (3e)	0	3	0	2	1	1	1	1	1	1	0	0	11
18 (2v)	0	0	0	0	0	0	0	0	0	0	0	0	0
19 (1a)	0	0	0	0	0	0	0	0	0	1	0	0	1
20 (5g)	1	0	0	0	0	0	0	0	0	0	0	0	1

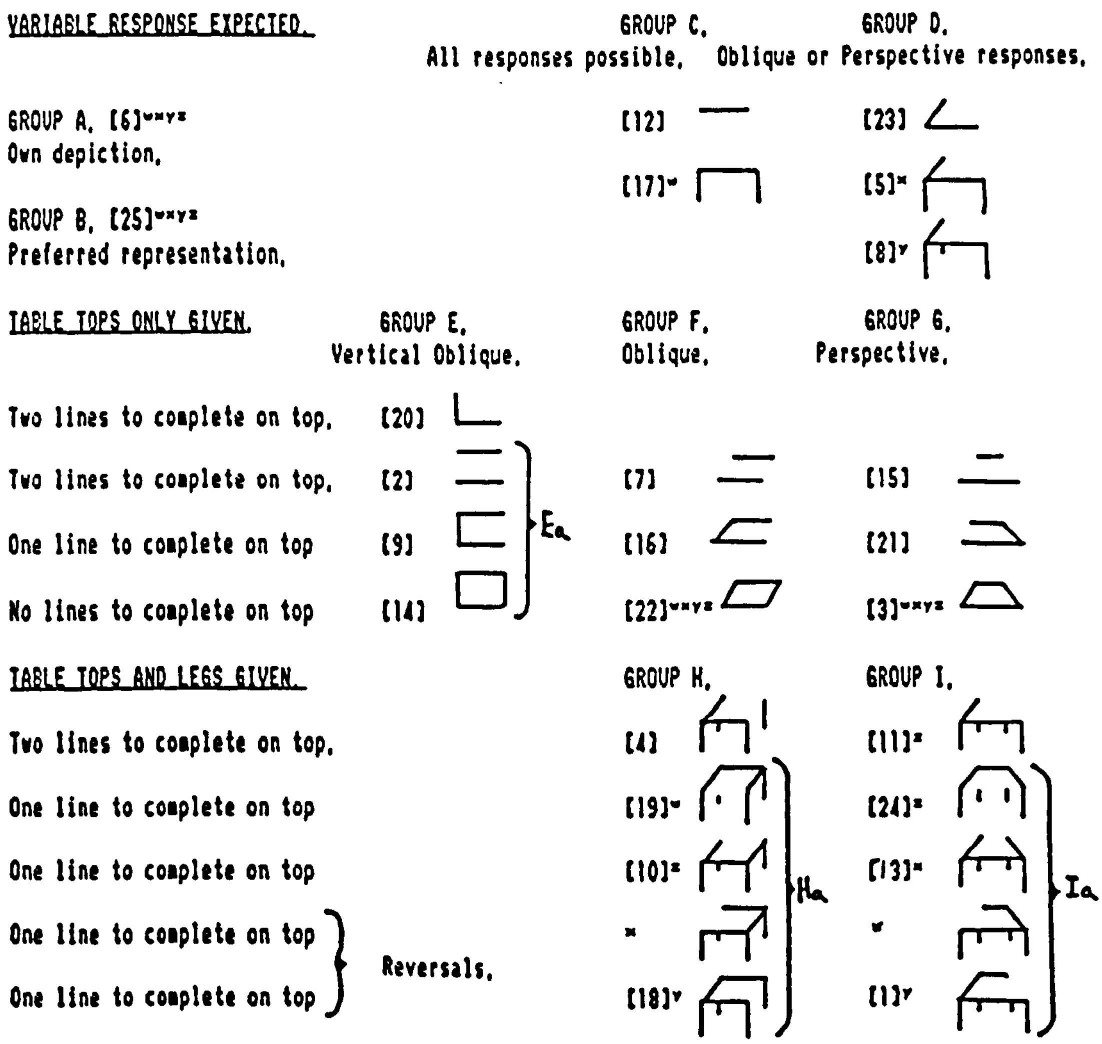
APPENDICES TO CHAPTER 8.

Completion of line drawings of tables.

Introduction.

Each subject was asked to respond to 25 stimuli. Table 3, given below, illustrates both the links between the stimuli and the stimuli that the younger subjects responded to (marked w, x, y and z).

TABLE 3. The structure behind the stimuli used in Study 8.



Appendix 8: A.

Data for Study 8.

Appendix 8:A contains the raw data discussed in Chapter 8. The responses were classified according to the method set out in Chapter 6. Each subjects responses on each of the stimuli are given below, however the data are presented in three parts. Ap.8:Aa and Ap.8:Ab give the data obtained on two different stimulus sheets (Stimulus sheets A and B respectively, discussed in Chapter 8) from the older subjects. Ap.8:Ac gives the data obtained from younger subjects who were presented with one of four different versions of a truncated stimulus sheet (Stimuli W, X, Y or Z).

In each part of this appendix the form of stimulus that the subject responded to is given at the head of the column. If there is a figure directly underneath this, it indicates the form of response that was expected. Extra lines have been added to some of the responses in Stimulus sheets W, X, Y and Z. A single line underneath the response indicates that the subject added a ground line to his or her completion. A square around the response indicates that the subject added a ground plane.

Appendix.8:Aa. The raw data obtained on Stimulus sheet A.

Stimulus A Completion Task.

no	sex	Age	4	2	4	3			3		2	3	4		4	2	4	3		3	3	2	4	3		4	CHOICE
1	m	26	4k	2q	4k	3h	3h	3h	3h	3h	2q	3h	3o	4o	4k	2j	4k	3h	1a	3h	3h	1a	4k	3h	3h	4k	3h
2	f	29	3k	2o	4k	3h	3h	3h	3h	3h	20	3h	4k	1a	4k	2o	4k	3h	1a	3h	3h	2o	4k	3h	3h	4k	3h
3	f	24	4k	2a	4k	3h	3h	2h	3h	3h	3o	3h	3o	3j	4k	2a	4k	3h	3j	3h	3h	2a	4k	3h	3h	4k	3h
4	f	32	3k	2o	4k	3h	3h	3h	3h	3h	2o	3h	3o	3h	4k	2o	4k	3h	2a	3h	3h	2o	4k	3h	3h	4k	3h
5	f	16	4k	2q	4k	3h	3h	3h	3h	3h	2a	3h	4k	3h	4k	2k	4k	3h	3a	3h	3h	2q	4k	3h	3h	4k	3h
6	m	40	4k	2q	4k	3h	3h	3h	3h	3h	2q	3h	4k	4g	4k	2q	4k	3h	1a	3h	3h	1a	4k	3h	4k	4k	3h
7	m	16	4k	2o	4k	3h	3h	3h	3h	3h	2o	3h	4k	4k	4k	20	4k	3h	1a	3h	3h	2o	4k	3h	3h	4k	3h
8	m	16	4k	2a	4k	3h	3h	4k	3h	4k	2a	3h	4k	2k	4k	2a	4k	3h	1a	3h	3h	2a	4k	3h	3j	4k	3h
9	f	17	3k	2o	4k	3h	3a	3j	3h	3h	2o	3h	3k	1a	4k	20	4k	3h	1a	3h	3h	2o	4k	3h	3j	4k	4k
10	m	16	3h	2x	4k	3h	3h	3h	3h	3h	2x	3h	3h	3g	4k	2x	4k	3h	3h	3h	3h	2x	4k	3h	3h	4k	3h
11	m	17	4k	2a	4k	3h	3h	3h	3h	3h	2a	3h	3h	3h	4k	2a	4k	3h	3h	3h	3h	2a	4k	3h	4k	4k	4k
12	m	17	4k	2q	4k	3h	3h	3h	3h	3h	2q	3h	4k	4k	4k	2q	4k	3h	4k	3h	3h	2q	4k	3h	4k	4k	3h
13	f	17	4k	2q	4k	3h	3h	3h	3h	3h	2q	3h	4k	3h	4k	2q	4k	3h	4k	3h	3h	2q	4k	3h	3h	4k	3h
14	m	17	4k	2o	4k	3h	3h	3h	3h	3h	2o	3h	4k	3h	4k	2o	4k	3h	3h	3h	3h	2o	4k	3h	3h	4k	3h
15	m	15	4k	2a	4k	3h	3h	3h	3h	3h	2a	3h	4k	3h	4k	2a	4k	3h	3h	3h	3h	3h	4k	3h	3h	4k	3h
16	f	15	3h	3h	4k	3h	3h	3h	3h	3h	3h	3h	4k	3h	4k	4k	4k	3h	2x	3h	3h	2o	4k	3h	3h	4k	3h
17	m	15	4k	2a	4k	3h	3h	3h	3h	3h	2a	3h	3h	3h	4k	2a	4k	3h	3h	3h	3h	2a	4k	3h	3h	4k	3h
18	m	15	4k	2q	4k	3h	3h	5g	3h	4k	2q	3h	4k	3h	4k	2q	4k	3h	2q	3h	3h	2q	4k	3h	4k	4k	3h
19	m	15	4k	2a	4k	3h	3h	3h	3h	3h	2q	3h	4k	4k	4k	2j	4k	3h	3h	3h	3h	1a	4k	3h	3h	4k	3h
20	f	16	4k	2o	4k	3h	3h	6s	3h	3h	2o	3h	4k	3h	4k	2o	4k	3h	4k	3h	3h	2o	4k	3h	3h	4k	4k
21	f	15	4k	2k	4k	4k	3h	3j	3h	3h	2o	3h	4k	3h	4k	2k	4k	3h	3h	3h	3h	2h	4k	3h	3h	4k	3h
22	f	15	4k	2a	4k	3h	3e	3h	3h	3h	2a	3h	3h	2h	4k	2h	4k	3h	3e	3h	3h	2a	4k	3h	3h	4k	3h
23	f	15	3h	2g	4k	3h	4k	4k	3h	3h	2h	3h	4k	3h	4k	2h	3h	3h	3h	3h	3h	2h	4k	3h	4g	4k	4k
24	f	15	4k	2o	4k	3h	3h	1a	3h	3h	2o	3h	4k	3h	4k	2o	4k	3h	3j	3h	3h	2o	4k	3h	4k	4k	3h
25	f	15	4k	2o	4k	3h	3h	3j	3h	4k	2o	3h	4k	3h	4k	2o	4k	3h	3h	3h	3h	2o	4k	3h	3j	4k	3j
26	m	15	4k	2e	4k	3h	3h	4a	3h	4k	2e	3h	4k	3h	4k	2e	4k	3h	3h	3h	3h	2e	4k	3h	3h	4k	4k
27	m	15	4k	3h	4k	3h	3a	3h	3h	4k	3h	3h	4k	3h	4k	2q	4k	3h	3j	3h	3h	3h	4k	3h	3j	4k	3h
28	f	15	4k	2a	4k	3h	3j	3j	3h	4k	2a	3h	4k	4k	4k	2a	4k	3h	3h	3h	3h	2a	4k	3h	3h	4k	3h
29	f	15	4k	2a	4k	3h	3e	3h	3h	3h	2a	3h	4k	3h	4k	2h	4k	3h	3h	3h	3h	2a	4k	3h	3h	4k	3h
30	f	15	4k	2a	4k	3h	3h	3h	3h	3h	2a	3h	4k	3h	4k	2a	4k	3h	4k	3h	3h	2a	4k	3h	4k	4k	3h
31	f	15	4k	2e	4k	3h	3h	3h	3h	4k	2e	3h	4k	3j	4k	2e	4k	3h	3h	3h	3h	2e	4k	3h	3h	4k	3h
32	f	15	4k	2k	4k	3h	3j	3j	3h	4k	2k	3h	4k	3h	4k	2k	4k	3h	3h	3h	3h	2k	4k	3h	4k	4k	3j
33	f	14	4k	4k	4k	3h	3h	3h	3h	4k	2k	3h	4k	3h	4k	2a	4k	3h	3j	3h	3h	2a	4k	3h	3h	4k	3h
34	f	14	4k	2q	4k	3h	3h	3e	3h	3h	2q	3h	4k	3e	4k	2q	4k	3h	3e	3h	3h	2q	4k	3h	3e	4k	3h
35	f	14	4k	2q	4k	3h	3h	3h	3h	4k	2q	3h	4k	3h	4k	2q	4k	3h	3h	3h	3h	2q	4k	3h	4k	4k	3h
36	f	14	4k	2k	4k	3h	3j	3h	3h	3h	3h	3h	4k	3h	4k	2j	4k	3h	3h	3h	3h	2k	4k	3h	3h	4k	3h
37	f	14	4k	2a	4k	3h	3h	3h	3h	3h	2a	3h	4k	1a	4k	2a	4k	3h	3h	3h	3h	2a	4k	3h	3h	4k	3h
38	f	14	4k	2k	4k	3h	3h	4k	3h	3h	2k	3h	3h	4k	4k	2k	4k	3h	3h	3h	3h	2k	4k	3h	4k	4k	3h
39	f	14	4k	2k	4k	3h	3h	3h	3h	3h	2k	3h	4k	3h	4k	2x	4k	3h	4k	3h	3h	2k	4k	3h	4k	4k	3h
40	f	14	4k	2k	4k	3h	3h	4k	3h	4k	2k	3h	4k	3h	4k	2k	4k	3h	4k	3h	3h	2k	4k	3h	4k	4k	3h
41	f	14	3h	2k	4k	3h	3h	3h	3h	4k	2k	3h	3h	3h	4k	2k	4k	3h	2k	3h	3h	2k	4k	3h	3h	4k	3h
42	f	14	4k	2q	4k	3h	3e	3e	3h	3e	2a	3h	4k	4k	4k	2a	4k	3h	3e	3h	3h	2q	4k	3h	3h	4k	2q
43	f	15	4k	2a	4k	3h	3e	3j	3h	3h	2e	3h	4k	4k	4k	2a	4k	3h	3e	3h	3h	2a	4k	3h	3h	4k	3h
44	f	14	4k	2a	4k	3h	3j	3h	3h	3h	2a	3h	4k	4k	4k	2h	4k	3h	4k	3h	3h	2a	4k	3h	3h	4k	4k
45	f	14	4k	2k	4k	3h	3h	3j	3h	4k	2k	3h	4k	3h	4k	2k	4k	3h	2o	3h	3h	1a	4k	3h	3h	4k	3h
46	m	14	4k	2k	4k	3h	3h	3h	3h	3h	2h	3h	3h	3h	4k	2k	4k	3h	3h	3h	3h	3h	4k	3h	3h	4k	3h
47	f	14	4k	2a	4k	3h	3h	3h	3h	4e	2a	3h	4k	3h	4k	2j	4k	3h	3h	3h	3h	2a	4k	3h	4k	4k	3h
48	f	15	4k	2a	4k	3h	3h	3j	3h	3h	2a	3h	4k	3h	4k	2a	4k	3h	1a	3h	3h	2a	4k	3h	3h	4k	3h
49	f	14	4k	4k	4k	3h	3h	6k	3h	3h	2o	3h	4k	3h	4k	2q	4k	3h	3h	3h	3h	3h	4k	3h	3h	4k	3h
50	f	14	4k	2q	4k	3h	4k	3j	3h	4k	2h	3h	4k	4k	4k	2h	4k	3h	2h	3h	3h	2h	4k	3h	4k	4k	3h
51	f	14	4k	4k	4k	3h	3j	3j	3h	3j	2j	3h	4k	3j	4k	2k	4k	3h	3e	3h	3h	2k	4k	3h	3j	4k	3h

Appendix.8:Aa. Continued.

Stimulus A Completion Task.

sub no	sex	age	4	2	4	3		own	3		2	3	4		4	2	4	3		3	3	2	4	3		4	choice
52	f	13	4k	2x	4k	3h	3h	3h	3h	4k	2x	3h	4k	3h	4k	2x	4k	3h	2x	3h	3h	2x	4k	3h	3h	4k	3h
53	f	13	4k	2k	4k	3h	3h	3e	3h	3h	2h	3h	3h	3h	4k	2e	4k	3h	1a	3h	3h	2q	4k	3h	3h	4k	3h
54	f	13	4k	2j	4k	3h	3h	2h	3h	4k	2h	3h	3h	2k	4k	2h	4k	3h	2k	3h	3h	2k	4k	3h	3h	4k	3h
55	f	13	4k	2a	4k	4k	3h	3h	3h	3h	2k	3h	4k	3e	4k	2k	4k	3h	3j	3h	3h	2e	4k	3h	3e	4k	3e
56	f	13	4k	2k	4k	3h	3j	3j	3h	3h	2k	3h	4k	2k	4k	2k	4k	3h	2k	3h	3h	2k	4k	3h	3h	4k	3k
57	f	13	4k	2x	4k	3h	3j	3j	3h	3h	2h	3h	4k	3j	4k	2h	4k	3h	2h	3h	3h	2h	4k	3h	3h	4k	3h
58	f	13	4k	2q	4k	3h	3j	3j	3h	3j	2q	3h	4k	3j	4k	2q	4k	3h	2e	3h	3h	2q	2q	3h	3j	4k	3h
59	f	13	4k	2k	4k	3h	3h	3j	3h	3h	2k	3h	4k	3h	4k	2k	4k	3h	3j	3h	3h	2k	4k	3h	3h	4k	3h
60	f	13	3h	2q	4k	2g	3f	3f	3h	3f	2q	3h	3h	3f	4o	2q	2q	3h	3f	3h	3h	2q	4q	3h	3f	4k	3h
61	f	13	4k	2h	4k	3h	3g	3j	3h	3h	kk	3h	4k	3f	4k	2h	4k	3h	3h	3h	3h	2k	4k	3h	3j	4k	3h
62	f	13	4k	2a	4k	3h	3e	3h	3h	4k	2q	3h	4k	3h	4k	2q	4k	3h	3j	3h	3h	2q	4k	3h	4k	4k	4k
63	f	13	4k	2q	4k	3h	3e	3e	3h	4k	2q	3h	4k	3e	4k	2q	4k	3h	3h	3h	3h	2q	4k	3h	3e	4k	3j
64	f	13	4k	2k	4k	3h	3j	3j	3h	3j	2k	3h	3k	3h	4k	2k	4k	3h	2k	3h	3h	2k	4k	3h	3h	4k	3h
65	f	13	4k	2k	4k	3h	3e	3k	3h	3h	2k	3h	3k	3h	4k	2k	4k	3h	3h	3h	3h	2k	4k	3h	3h	4k	3h
66	f	13	3k	2k	4k	3h	3h	2h	3h	3h	2h	3h	3k	3h	4k	2a	4k	3h	4k	3h	3h	2h	4k	3h	3h	4k	3h
67	f	13	4k	2k	4k	3h	3h	3j	3h	4k	2k	3h	3h	3h	4k	2k	4k	3h	3h	3h	3h	2k	4k	3h	3h	4k	3h
68	f	12	4k	2h	4k	4k	3h	3h	3h	3h	2o	3h	3h	3h	4k	2h	4k	3h	2h	3h	3h	2h	4k	3h	3h	4k	3h
69	f	12	4k	2a	4k	3h	3e	4k	3h	3j	2a	3h	4k	4k	4k	aa	4k	3h	4a	3h	3h	2a	4k	3h	3e	4k	3h
70	f	12	4k	2q	4k	3h	3h	3h	3h	3h	2o	3h	3k	3h	4k	2o	4k	3h	2o	3h	3h	2o	4k	3h	3h	4k	3h
71	f	12	4k	2k	4k	3h	3h	3h	3h	3h	2h	3h	4k	1a	4k	2x	4k	3h	1k	3h	3h	2x	4k	3h	3f	4k	3h
72	f	12	4k	2a	4k	3h	3h	3h	3h	3h	2e	3h	4k	3h	4k	2k	4k	3h	1k	3h	3h	2g	4k	3h	3h	4k	3h
73	f	12	4k	2a	4k	3h	3h	3h	3h	3h	2o	3h	4k	3h	4k	2a	4k	3h	3a	3h	3h	2o	4k	3h	3h	4k	3h
74	f	12	4k	2k	4k	3h	3h	4k	3h	4k	2k	3h	4k	3h	4k	2k	4k	3h	3h	3h	3h	2k	4k	3h	3h	4k	3h
75	f	12	3h	2h	4k	3h	3h	3j	3h	3h	2h	3h	3h	3j	4k	2h	4k	3h	2h	3h	3h	2h	4k	3h	3h	4k	3h
76	f	12	4k	2h	4k	3h	3h	3j	3h	4k	2h	3h	4k	3h	4k	2h	4k	3h	3h	3h	3h	2h	4k	3h	3h	4k	3h
77	m	11	4k	2k	4k	3h	3e	4g	3h	4k	2k	3h	3k	2h	4k	2k	4k	3h	2j	3h	3h	2k	4k	3h	3h	4k	3h
78	m	11	4k	2q	4k	3h	3e	5e	3h	3h	2q	3h	3k	3h	4k	2q	4k	3h	4a	3h	3h	2q	4k	3h	3e	4k	5e
79	m	11	4k	2o	4k	3h	3h	5o	3h	4k	2o	3h	4k	2o	4k	2o	4k	3h	2o	3h	3h	2o	4k	3h	4k	4k	5a
80	m	11	4k	2o	4k	3h	3h	4k	3h	4k	2o	3h	4k	1a	4k	2o	4k	3h	2o	3h	3h	2o	4k	3h	4k	4k	3h
81	m	11	4k	2o	4k	3h	3h	4k	3h	4k	2o	3h	4k	3h	4k	2h	4k	3h	3h	3h	3h	2o	4k	3h	4k	4k	3h
82	m	11	4k	2k	4k	3h	3h	3h	3h	3h	2k	3h	3k	2k	4k	2o	4k	3h	2a	3h	3h	2a	4k	3h	4a	4k	3h
83	m	12	4k	2k	4k	3h	4k	2j	3h	4k	2k	3h	4k	2k	4k	2k	4k	3k	2k	3h	3h	2k	4k	3h	4k	4k	3h
84	m	11	4k	3k	4k	3h	3h	4k	3h	4k	2o	3h	4k	2j	4k	2k	4k	3h	2k	3h	3h	3h	4k	3h	3h	4k	3h
85	m	11	4k	2o	4k	3h	4k	3h	3h	3k	2o	3h	4k	2o	4k	2o	4k	3h	2k	3h	3h	2o	4k	3h	3j	4k	4k
66	m	11	4k	2q	4k	3h	3h	4k	3h	3k	2q	3h	4k	3h	4k	2q	4k	3h	2q	3h	3h	2f	4k	3h	4k	4k	3h
87	m	11	4k	2k	4k	3h	3e	4k	3h	4k	2a	3k	3k	4k	4k	2k	4k	3h	2k	3k	3k	2k	4k	3k	4k	4k	4k
88	m	12	4k	2h	4k	3h	3e	4k	3h	4k	2h	3k	4k	4k	4k	2h	4k	3h	3h	3h	3h	2j	4k	3h	4k	4k	4k
89	m	11	4k	2a	4k	3h	3h	3h	3h	3h	2a	3h	3k	3h	4k	2a	4k	3h	4k	3h	3h	2a	4k	3h	3h	4k	3h
90	f	11	4k	2k	4k	3h	3e	3h	3h	4k	2q	3k	4k	4k	4k	2q	4k	3h	3h	3k	3k	2q	4k	3h	4k	4k	4k
91	m	10	3k	2x	4k	3h	3h	2x	3h	4k	2a	3h	4k	2a	4k	2a	4k	3a	2a	3h	3h	2a	3a	3a	3a	4k	3h
92	m	10	4k	2a	4k	3h	4a	4a	3h	4k	2a	3h	4k	2a	4k	2k	4k	3h	2a	3h	3k	2h	4k	3h	3h	4k	3h
93	m	10	4k	2k	4k	3h	3k	2a	3h	3h	2k	3h	4k	4k	4k	2h	4k	3h	2q	3h	3h	2q	4k	3q	4k	4k	3h
94	f	10	3k	2k	4k	3h	3k	3j	3h	3h	2k	3h	3k	3j	4k	2k	4k	3h	3j	3h	3h	2k	4k	3h	3j	4k	3h
95	f	10	4k	2k	4k	3h	3h	2k	3h	3h	2k	3h	3k	3h	4k	2h	4k	3h	2k	3h	3h	2h	4k	3h	3j	4k	2k
96	m	10	4k	2l	4k	3h	4k	2l	3h	4k	2l	3h	4k	4a	4k	2l	4k	3h	2l	3h	3h	2l	4k	3h	4k	4k	3h
97	f	10	4k	2k	4k	3h	3h	4k	3h	3h	2k	3h	4k	3j	4k	2k	4k	3h	3j	3h	3h	2k	4k	3h	3j	4k	3h
98	m	10	4k	2k	4k	3h	4k	3e	3h	4k	2k	3h	4k	4g	4k	2k	4k	3h	2x	3h	3h	2l	4k	3h	4g	4k	3e
99	m	10	4k	2k	4k	3h	3h	3j	3h	3h	2k	3h	4k	2k	4k	2k	2k	3h	3j	3h	3h	2k	4k	3h	3k	4k	3h
100	m	10	4k	2l	4k	3h	3h	3h	3h	3h	2l	3h	4k	3h	4k	2k	4k	3h	3h	3h	3h	2l	4k	3h	3h	4k	3h
101	f	10	4k	2k	4k	3h	3h	5h	3h	3k	2k	3h	4k	2k	4k	2k	4k	3h	2k	3h	3h	2k	4k	3h	3j	4k	2k
102	f	10	4k	2g	4k	3h	3h	3j	3h	4k	2g	3h	4k	4k	4k	2g	4k	3h	2k	3h	3h	2k	4k	3h	4g	4k	3j

Appendix.8:Aa. Continued.

Stimulus A Completion Task.

Sub no	Sex	Age	4	2	4	3		own	3		2	3	4		4	2	4	3		3	3	2	4	3		4	CHOICE
103	f	10	4k	2k	4k	3h	3h	3j	3h	4k	2l	3h	3k	3l	4k	2g	4k	3h	2h	3h	3h	2k	4k	3h	3h	4k	3h
104	m	10	3k	2g	4k	3h	3f	3h	3h	3h	2g	3h	4k	3h	4k	2g	4k	3f	3h	3h	3h	2k	4k	3h	3f	4k	3h
105	m	10	4k	2g	4k	3h	3f	2q	2k	4k	2k	3h	3k	2k	4k	2g	4k	3h	2a	3h	3h	2k	4k	3h	4k	4k	3h
106	f	10	4k	2k	4k	3h	3h	4k	3h	3h	2k	3h	4k	3j	4k	2k	4k	3h	2k	3h	3h	2k	4k	3h	3h	4k	4k
107	m	10	4k	2l	4k	3k	4k	4k	3h	4k	2k	3k	4k	2r	4k	2r	4k	3k	4k	3k	3k	2r	4k	3k	3k	4k	3k
108	m	10	3k	2g	4x	4x	4x	2h	2g	4g	2g	3h	4g	2g	4g	2g	2g	3l	2l	3h	3h	2l	4k	3h	4a	4g	3h
109	m	9	4k	2k	4k	3h	3j	3j	2l	3k	2k	3h	3k	2h	4k	2h	2h	3j	2l	3h	3h	2h	2h	3h	4h	4k	3h
110	f	9	4k	2k	4k	3k	9k	3k	3k	9k	2g	3k	9k	2k	4k	2k	4k	3k	2k	3k	3k	2k	4k	3k	9k	4k	3k
111	m	9	4k	2k	4k	3k	3e	2l	3h	3k	2l	3h	4k	2l	4k	2l	4k	3h	2x	3h	3h	2k	4k	3k	9k	4k	4k
112	m	9	4k	2k	4k	3k	9k	3k	3h	4k	2o	3k	4k	4k	4k	2o	4k	4k	4k	3k	3k	20	4k	3k	4k	4k	3k
113	f	9	3k	2k	4k	3h	3h	4k	3h	3h	2h	3h	3k	2a	4k	2h	4k	3h	3h	3h	3h	2h	4k	3h	3h	4k	3h
114	m	9	4k	2k	4k	3h	3k	3h	3k	3k	2k	3h	3k	2k	4k	2k	4k	3k	2k	3h	3k	2k	4k	3k	4k	4k	3h
115	m	9	4k	2x	4x	3h	3x	2x	3x	3k	2x	3k	3k	2x	4k	2l	4k	3l	2l	3k	3k	2l	4l	3l	4l	4k	3h
116	m	9	4k	2k	4k	4k	9a	2h	3j	4k	2k	3h	4k	2k	4k	2k	4k	3h	2h	3h	3h	2k	4k	3h	4k	4k	3h
117	f	9	4k	2k	4k	3h	3h	2k	3j	3h	2k	3h	3k	2k	4k	2k	4k	3j	2k	3h	3h	2k	4k	3h	3h	4k	3h
118	f	9	4g	2g	4g	4g	2x	2k	2j	3h	2k	3k	4k	2k	4k	2k	2k	2k	2k	2k	3k	2k	2k	3k	3k	4k	3k
119	f	9	4k	2k	4k	3h	3k	2h	3k	3h	2g	3k	4k	2g	2g	2g	4g	3g	2g	-	-	2l	4l	3g	3g	-	3k
120	m	9	4k	2x	4g	3f	4g	2l	3j	4g	2g	3h	4k	2l	4k	2l	4g	3l	2l	3h	3h	2l	4g	3l	9g	4k	3h
121	f	9	4k	2g	4k	3h	4k	2h	3g	4k	2g	3h	4k	2g	4k	2g	2g	3g	2l	3h	3h	2g	3g	3j	2g	4k	3h
122	f	9	4k	2g	4g	3h	3h	2g	3g	3k	2g	3h	3k	2g	4k	2g	4g	3g	2g	3h	3h	2g	4g	3g	4g	4k	3h
123	f	9	3k	2k	4k	3h	3k	2k	3h	4k	2k	3h	4k	2k	4k	2k	4k	3h	2g	3h	3h	2k	4k	3h	3h	4k	3h
124	f	9	3k	2k	4k	4k	9a	2h	3q	3h	2a	3k	4k	2a	4k	2a	4a	3q	2a	3h	3k	2a	4a	3q	4a	4k	3k
125	f	9	4k	2g	4k	3h	4k	2g	3k	4k	2g	3h	4k	2g	4k	2k	4k	3g	2g	3h	3h	2g	4k	3k	4k	4k	3h
126	f	8	3k	2k	4k	3k	3k	1a	2k	4k	2k	3k	3k	2a	4k	2k	4k	3a	2k	3k	3k	2k	2k	3k	3k	4k	3k
127	m	8	4g	2g	4g	3h	3h	2x	3h	2g	2g	3h	4g	7l	4g	2g	4g	3g	2k	3h	3h	2a	4k	3h	4k	4g	7l
128	f	8	3k	2k	4k	3h	3h	3a	3k	3k	2k	3h	4k	2k	4k	2k	3q	3h	2k	3h	3h	2a	4a	3e	4k	4k	3h
129	f	8	4g	2g	4g	2g	3g	2g	3j	4g	3g	3j	4g	2g	4g	2g	4g	3j	2g	3j	3j	2g	4g	3g	4g	4g	3j
130	m	8	4g	2g	4g	3k	4k	2k	2k	4k	2k	3h	4g	2k	4k	2o	4k	4k	2k	3h	3k	2k	4k	3k	4k	4k	3h
131	f	8	3g	2a	2g	3j	9g	2g	2g	9g	2g	3h	2g	2g	4g	2g	2g	2g	2g	3f	2g	2g	2g	3g	9g	4g	3f
132	f	8	4g	2g	4g	2g	3f	2g	3g	2g	2g	3f	4g	2g	4g	2g	4g	3g	2g	3f	3j	2g	4g	3g	4g	4g	4g
133	f	8	4k	2a	4a	3a	9a	2a	2a	3h	2a	3h	4k	2a	4k	2a	2a	3a	2a	3h	3h	2a	2a	3a	9a	4a	3h
134	m	8	4k	2k	4k	3k	4k	3k	2k	4k	2k	3k	4k	4k	4k	2k	4k	4k	2k	3k	3k	2k	4k	3k	4k	4k	3k
135	m	8	4k	2l	4k	3j	3h	4k	3h	4g	2a	3j	3g	4a	4g	2a	4a	3a	2a	3h	3h	2a	4a	3e	3a	4g	3h
136	m	8	4k	2o	4g	3h	4a	2a	2a	4k	2k	3h	4k	2a	4k	2a	2a	3a	2a	3h	3k	4k	4a	3a	4a	4k	3h
137	f	7	4k	2k	4g	3k	3k	2l	3e	4k	2l	3k	3k	2g	4k	2g	2g	3e	2e	3k	3k	3h	4k	3h	3j	4k	3k
138	m	7	4k	2v	4k	3h	4a	2k	2k	4k	2v	3h	3k	2g	4k	2v	2v	4k	4a	3k	3k	2k	4k	3k	4k	4k	4k
139	f	7	4k	2g	4g	3h	3k	2g	2g	4k	2g	3k	3k	2g	4k	2g	2g	2g	2g	3h	3h	2g	4g	3g	4g	4k	3h
140	f	7	4y	2x	4x	3h	3g	2g	3y	4y	2x	3h	4k	2y	4k	2k	4k	3g	2g	3h	3h	2k	4g	3g	4g	4k	4k
141	m	7	4a	2o	4g	2g	9k	4k	3x	4a	2o	3h	4k	2k	4k	2k	2k	3k	2k	3h	3h	2k	4k	3k	3k	4g	3h
142	f	7	4k	2k	4k	4k	4k	2g	3k	2k	2k	3k	9k	3k	4k	2k	4k	2k	2k	3f	3f	2k	2k	3k	3k	4k	4k
143	f	7	4k	2a	2o	3f	4k	2a	2o	4g	2a	3k	4k	2a	4k	2a	2a	3a	2a	3k	3k	2a	4a	3a	4k	4k	3k
144	f	7	4k	3k	4k	4k	4k	2k	3k	4g	2g	3k	4k	2g	4k	2k	4k	3k	2k	3k	3k	2g	2g	3k	4k	4k	3k
145	f	7	2k	2g	4g	3h	3e	2g	2g	3j	2g	3h	4k	2g	4k	2g	2g	2g	2g	3h	3h	2g	2g	3g	2g	2g	3h
146	f	7	4k	2k	4k	3h	3e	2k	2k	3h	2k	3h	3g	2k	4k	2k	2k	3f	2g	3h	3h	2k	4k	3f	3g	4g	3h
147	f	6	4k	2a	4a	3h	9a	3e	7a	4a	2a	3h	4k	2a	4k	2a	4a	3e	2a	3h	3h	2a	4a	3e	4a	4k	3h
148	m	6	4x	2x	4x	3h	3l	2l	2l	3f	2h	3h	3k	2l	4k	2h	2h	3f	2v	3h	3h	2e	2x	3f	3f	4x	3h
149	f	24	4k	2o	4k	3h	3h	3h	3h	3h	2o	3h	4k	3h	4k	2o	4k	3h	3h	3h	3h	2o	4k	3h	3h	4k	3h
150	f	8	4g	2x	4x	2x	2x	2x	2x	2x	2x	3j	2x	2x	2x	2x	2x	2x	2x	3h	3j	2x	2x	3x	3x	2x	3h
151	f	8	4k	2k	4k	4k	4k	2k	3k	4k	2g	3k	4k	2k	4k	2k	4k	3k	2a	3h	3h	2k	4k	3k	4k	4k	3h
152	f	8	4k	4k	4k	3h	3k	3k	3k	4k	3k	3h	4k	4k	4k	2k	4k	3k	2k	3h	3h	4k	3k	3e	3h	4k	3h
153	f	8	3f	2a	4g	3h	9g	2g	3j	9g	2g	3j	4g	2a	4g	2g	2g	4g	2g	3j	3j	2g	4g	3g	3g	4g	3h

Appendix.8:Aa. Continued.

Stimulus A Completion Task,

sub no	Sex	Age	4	2	4	3		own	3		2	3	4		4	2	4	3		3	3	2	4	3		4	CHOIC
154	f	8	4k	2k	4k	4k	4k	2a	3k	4k	2k	3k	4k	2k	4k	2k	4k	3k	3k	3k	3k	2k	4k	3k	4k	4k	3k
155	f	9	4k	2a	4k	3h	4k	3j	3h	3h	2a	3h	4k	2k	4k	2a	41	3h	2a	3h	3h	2a	4k	3h	3h	4k	3h
156	f	7	4k	2k	4k	3h	3h	2k	2k	2k	2k	3k	3k	2k	4k	2k	2k	4k	2k	3h	3h	2k	4k	3h	4k	4k	3k
157	f	7	4k	2x	4k	4k	9k	2q	3h	4k	2q	3h	4k	4k	4k	2a	4k	3h	3h	3h	3h	2a	4k	3h	4k	4k	3h
158	m	43	4k	2a	4k	3h	3h	5o	3h	3h	2a	3h	4k	3e	4h	2a	4k	3e	2o	3h	3h	2o	4o	3o	9k	4k	5o
159	m	39	2a	4a	3h	3h	6e	3h	3h	2a	3h	4k	3j	4k	3j	4k	21	4k	3h	3h	3h	2a	4k	3h	3h	4k	21
160	m	37	4k	2o	4a	3h	3h	3h	3h	3h	2a	3h	4k	1a	4k	2a	1a	3h	1a	3h	3h	2a	4a	3h	3h	4k	3h
161	f	16	4k	21	4k	3h	3h	3h	3h	4k	21	3h	4k	4k	4k	21	4k	3h	3h	3h	3h	21	4k	3h	4k	4k	3h
162	f	16	4k	21	4k	3h	3h	3j	3j	3j	21	3h	3k	1a	4k	21	4k	3j	21	3h	3h	21	4k	3j	4k	4k	3h
163	m	16	4k	2k	4k	3h	3h	3h	3h	4k	2z	3h	4k	4k	4k	2z	4k	3h	4k	3h	3h	2k	4k	3h	4k	4k	3h
164	f	17	4k	2a	4k	3h	3h	3e	3e	4k	2a	3h	4k	3h	4k	2k	4k	3h	3h	3h	3h	2a	4k	3h	3h	4k	3h
165	m	18	4k	2o	4k	3h	3h	3h	3h	3h	2o	3h	4k	3h	4k	2o	4k	3h	3h	3h	3h	2o	4k	3h	3h	4k	3h
166	m	17	4k	2a	4k	3h	3h	3h	3h	3h	2a	3h	4k	3e	4k	2a	4k	3h	4k	3h	3h	2a	4k	3h	3h	4k	3h
167	m	17	3k	3j	4k	3h	3h	3a	3e	3j	2q	3h	3k	3h	4k	2q	4k	3h	3h	3h	3h	3h	4k	3h	4k	4k	3h
168	m	18	4k	2o	4k	3h	3h	3h	3h	3h	2o	3h	4k	3h	4k	2o	4k	3h	3h	3h	3h	2o	4k	3h	3h	4k	3h

Appendix.8:Ab. The raw data obtained on Stimulus sheet B.

Stiaulus B, Coapletion Task,

sub no.	SEX	AGE	OWN		3	4	2	4		4	3	2		3	3		3	4	2	4	4		3	4	2	3	CHOICE
169	a	31	3e	3h	3h	4k	3h	4k	3h	3k	3h	2o	3h	3h	3h	3h	3h	3h	2o	4k	4k	3h	3h	3h	2o	3h	3e
170	f	33	3h	3h	3h	4k	2a	4k	3h	4k	3h	2a	3h	3h	3h	4a	3h	4k	2a	4k	4k	3h	3h	4k	2a	3h	3h
171	f	38	5h	3h	3h	4k	3h	3k	3h	3k	3h	2o	3h	3h	3h	3h	3h	4k	2o	4k	4k	3h	3h	4k	2o	3h	3h
172	f	57	4k	4k	3h	4k	2o	4k	6k	4k	3h	2h	3h	3h	3h	3h	3h	4k	2o	4k	4k	3h	3h	4k	2k	3h	4k
173	f	16	3h	3h	3h	4k	2q	4k	3h	4k	3h	2q	3h	3h	3h	3h	3h	4k	2q	4k	4k	3h	3h	4k	2q	3h	3h
174	f	17	3h	3h	3h	4k	2q	4k	3h	4k	3h	2q	3h	3h	3h	3h	3h	4k	2q	4k	4k	3h	3h	4k	2q	3h	3h
175	a	16	3e	3e	3h	4k	2k	4k	3e	3k	3h	2k	3h	3h	3h	3h	3h	4k	2k	4k	4k	4k	3h	3h	2k	3h	4k
176	a	16	3h	3h	3h	4k	2o	4k	4k	3h	3h	2q	3h	3h	3h	4k	3h	4k	2q	4k	4k	3h	3h	4k	2o	3h	3h
177	f	16	3h	3h	3h	4k	3h	4k	3h	4k	3h	2q	4k	3h	3h	3h	3h	4k	2a	4k	4k	3h	3h	4k	2a	3h	3h
178	f	17	3h	4k	3h	4k	2q	4k	3h	4k	3h	2q	4k	3h	3h	3h	3h	4k	2q	4k	4k	3h	3h	4k	2q	3h	4k
179	f	17	3h	3h	3h	4k	4k	4k	3h	4k	3h	3h	3h	3h	3h	3h	3h	4k	2q	4k	4k	3h	3h	4k	3h	3h	3h
180	a	17	3h	3h	3h	4k	2o	4k	3h	4k	3h	2o	3h	3h	3h	4k	3h	4k	2o	4k	4k	3h	3h	4k	2o	3h	3h
181	a	17	3h	3h	3h	4k	2q	4k	3h	4k	3h	2q	3h	3h	3h	3h	3h	4k	2q	4k	4k	3h	3h	4k	2q	3h	4k
182	a	15	3h	3h	3h	4k	2a	4k	3h	4k	3h	2a	3h	3h	3h	3h	3h	4k	2a	4k	4k	4k	3h	4k	2a	3h	3h
183	a	15	3h	3h	3h	4k	2a	4k	2a	3h	3h	2q	3h	3h	3h	2a	3h	4k	2a	4k	4k	3e	3h	4k	2a	3h	3h
184	a	15	3h	3h	3h	4k	2k	4k	3h	4k	3h	2a	4k	3h	3h	4k	3h	4k	2a	4k	4k	4k	3h	4k	2a	3h	3h
185	f	15	3h	3h	3h	4k	2o	4k	3h	4k	3h	2o	3h	3h	3h	3h	3h	4k	2o	4k	4k	3h	3h	4k	2o	3h	3h
186	f	15	3h	3h	3h	4k	2a	4k	3h	3h	3h	2a	3h	3h	3h	2a	3h	4k	2a	4k	4k	3h	3h	4k'	2a	3h	3h
187	f	15	4k	3h	3h	4k	2q	4k	3h	3h	3h	2o	3h	3h	3h	2o	3h	4k	2o	4k	4k	3h	3h	4k	2o	3h	3h
188	f	15	2e	3h	3h	4k	2a	4k	2o	4k	3h	2o	4k	3g	3h	3h	3h	4k	2o	4k	4k	4k	3h	4k	2o	3h	3h
189	f	15	3j	3h	3h	4k	2k	4k	3j	3k	3h	2k	3h	3h	3h	2k	3h	4k	2g	4k	4k	3j	3h	3j	2k	3h	3h
190	f	15	3j	3h	3h	4k	2o	4k	3j	4k	3h	2o	3h	3h	3h	3h	3h	4k	2o	4k	4k	4k	3h	4k	2o	3h	3j
191	a	15	2k	2a	3h	4k	2k	4k	7h	3k	3h	2k	3h	3h	3h	2k	3h	4k	2k	4k	4k	4k	3h	4k	2k	3h	3h
192	a	15	5k	3h	3h	4k	2a	4k	3h	4k	3h	2o	3h	3h	3h	3h	3h	4k	2q	4k	4k	3h	3h	4k	2q	3h	3h
193	a	15	3h	3j	3h	4k	3h	4k	3h	3h	3h	3h	4k	3h	3h	3h	3h	4k	2q	4k	4k	3h	3h	4k	3h	3h	3h
194	a	15	3h	3h	3h	4k	3h	4k	3h	4k	3h	3h	3h	3h	3h	3h	3h	4k	3h	4k	4k	4k	3h	4k	3h	3h	3h
195	f	15	3h	3h	3h	4k	2a	4k	3h	4k	3h	2a	3h	3h	3h	3h	3h	4k	2a	4k	4k	3h	3h	4k	2a	3h	3h
196	f	15	3h	3h	3h	4k	2k	4k	2k	4k	3b	2k	3h	3h	3h	2k	3h	4k	2k	4k	4k	4k	3h	4k	2k	3h	3h
197	f	15	3h	3h	3h	4k	2k	4k	3h	4k	3h	2k	3h	3h	3h	3h	3h	4k	2k	4k	4k	3h	3h	4k	2k	3h	4k
198	f	15	3j	3h	3h	4k	2k	4k	3h	4k	3h	2k	4k	3h	3h	3h	3h	4k	2k	4k	4k	3h	3h	4k	2k	3h	4k
199	f	14	3e	3h	3h	4k	2a	4k	3h	4k	3h	2a	4k	3h	3h	9a	3h	4k	2o	4k	4k	4k	3h	4k	4k	3h	3h
200	f	14	3h	3h	3h	4k	2q	4k	3h	4k	3h	3h	3h	3h	3h	4k	3h	4k	2q	4k	4k	3h	3h	4k	2q	3h	3h
201	f	14	3h	3h	3h	4k	2q	4k	3g	4k	3h	2q	4k	3g	3h	2q	3h	4k	2q	4k	4k	3g	3h	4k	2q	3h	3g
202	f	14	3e	3h	3h	4k	2e	4k	3h	4k	3h	2e	4k	3h	3h	3e	3h	4k	2k	4k	4k	3e	3h	4k	2a	3h	3h
203	f	14	3h	3h	3h	4k	2a	4k	3j	3h	3h	2g	3h	3h	3h	2g	3h	4k	2a	4k	4k	3e	3h	4k	3e	3h	3h
204	f	14	3e	3h	3h	4k	2a	4k	1a	4k	3h	2a	3j	3h	3h	2k	3j	4k	2a	4k	4k	3h	3h	4k	2a	3h	4k
205	f	14	3h	3h	3h	4k	2k	4k	3h	4k	3h	2e	3h	3h	3h	3h	3h	4k	2j	4k	4k	3h	3h	4k	2j	3h	4k
206	f	14	3j	3h	3h	4k	2k	4k	3h	4k	3h	2k	4k	3h	3h	3h	3h	4k	2k	4k	4k	3h	3h	4k	2k	3h	3h
207	f	15	4k	3h	3h	4k	2k	4k	3h	3h	3h	2k	3h	3h	3h	3h	3h	4k	2k	4k	4k	3h	3h	4k	2k	3h	4k
208	f	14	3h	3h	3h	4k	2a	4k	3e	4k	3h	2a	4k	3h	3h	4k	3h	4k	2a	4k	4k	3e	3h	4k	2a	3h	4k
209	f	14	3e	3e	3h	4k	2a	4k	3e	4k	3h	2q	3h	3h	3h	3e	3h	4k	2a	4k	4k	3e	3h	4k	2q	3h	4k
210	f	14	3h	3h	3h	4k	3h	4k	3h	3h	3h	2x	4k	3h	3h	4k	3h	4k	2x	4k	4k	4k	3h	4k	2x	3h	3h
211	f	14	3h	3h	3h	4k	2a	4k	4k	4k	3h	2a	3h	3h	3h	4k	3h	4k	2a	4k	4k	3h	3h	4k	2a	3h	4k
212	a	14	1k	3h	3h	4k	2v	4k	1k	3h	3h	2v	4k	3h	3h	3h	3h	4k	2v	4k	4k	3h	3h	4k	2v	3h	3h
213	f	14	3h	3e	3h	4k	2a	4k	4k	4k	3h	2a	4k	3h	3h	2a	3h	4k	2a	4k	4k	4k	3h	4k	2q	3h	3h
214	f	14	3h	3e	3h	4k	3e	4k	3e	4k	3h	3e	3h	3h	3h	3e	3h	4k	3e	4k	4k	4k	3h	4k	3e	3h	3h
215	f	14	3h	3h	3h	4k	4k	4k	3g	4k	3h	2k	3h	3h	3h	3h	3h	4k	2h	4k	4k	3h	3h	4k	2h	3h	3h
216	f	15	3h	3h	3h	4k	2a	4k	3h	3h	3h	2a	3h	3h	3h	3h	3h	4k	2a	4k	4k	3h	3h	4k	2a	3h	3h
217	a	23	3e	3h	3h	4k	2a	4k	3h	3k	3h	2a	3h	3h	3h	3h	3h	3o	2o	4k	4k	3e	3h	4k	2o	3h	3e
218	f	13	2j	3h	3h	4k	2j	4k	2j	3k	3h	2j	3h	3h	3h	3h	3h	4k	2j	4k	4k	3h	3h	4k	2j	3h	3h

Appendix.8:Ab. Continued.

Stimulus 8, Completion Task.

no.	sex	age	own		3	4	2	4		4	3	2		3	3		3	4	2	4	4		3	4	2	3	choice
219	f	13	5g	3h	3h	4k	2q	4k	3f	4k	3h	2q	3h	3h	3h	2q	3h	4k	2q	4k	4k	3f	3h	4k	2q	3h	3h
220	f	13	3h	3h	3h	4k	2k	4k	3h	3k	3h	2k	3h	3h	3h	3e	3h	4k	2k	4k	4k	3h	3h	4k	2k	3h	3h
221	f	13	3h	3h	3h	4k	2k	4k	3h	3k	3h	2e	3h	3h	3h	2o	3h	4k	2a	4k	4k	3j	3h	4k	2a	3h	3h
222	f	13	3h	3h	3h	4k	2a	4k	3h	3h	3h	2a	3h	3h	3h	3h	3h	4k	2k	4k	4k	3h	3h	4k	2a	3h	3h
223	f	13	3h	3h	3h	4k	2k	4k	1a	3h	3h	2a	3h	3h	3h	3h	3h	4k	2k	4k	4k	3h	3h	4k	2a	3h	3h
224	f	13	6s	3h	3h	4k	3j	4k	3h	4k	3h	3h	4k	3h	3h	3h	3h	4k	2q	4k	4k	3j	3h	4k	3h	3h	3h
225	f	13	3h	3h	3h	4k	2k	4k	4k	4k	3h	2q	3h	3h	3h	4k	3h	4k	2q	4k	4k	4k	3h	4k	2q	3h	3h
226	f	13	3h	3h	3h	4k	2q	3h	3e	3h	3h	2a	3h	3h	3h	3e	3h	4k	2a	4k	4k	3e	3h	4k	2k	3h	3h
227	f	13	4k	3h	3h	4k	2k	4k	3h	3h	3h	2a	3h	3h	3h	3h	3h	4k	2k	4k	4k	3h	3h	4k	2k	3h	4k
228	f	13	2j	3j	3h	4k	2j	4k	2j	3h	3h	2j	3j	3h	3h	2j	3h	4k	2a	4k	4k	3j	3h	4k	2j	3h	3h
229	f	13	3e	3h	3h	4k	2e	4k	1o	4k	3h	2e	4k	3h	3h	2e	3h	4k	2e	4k	4k	4k	3h	4k	2e	3h	3h
230	f	13	3e	3h	3h	4k	2k	4k	3e	3h	3h	2k	3h	3h	3h	3e	3h	4k	2a	4k	4k	3e	3h	4k	2a	3h	3h
231	f	13	3j	3h	3h	4k	2e	4k	3e	3h	3h	2q	3j	3h	3h	3e	3h	4k	2q	4k	4k	3e	3h	4k	2q	3h	3h
232	f	14	3j	3h	3h	4k	2h	4k	3h	3h	3h	2h	3k	3h	3h	3h	3h	4k	2h	4k	4k	3h	3h	4k	2h	3h	3h
233	f	12	2h	4a	3h	4k	2a	4k	9a	4k	3h	2a	3h	3h	3h	2s	3h	4k	2x	4k	4k	4k	3h	4k	2a	3h	4k
234	f	12	3h	3h	3h	4k	2q	4k	3h	3h	3h	2q	3h	3h	3h	3h	3h	4k	2q	4k	4k	3h	3h	4k	2q	3h	4k
235	f	13	3h	3h	3h	4k	2a	4k	3h	3k	3h	2o	3h	3h	3h	2k	3h	4k	2k	4k	4k	4k	3h	4k	2k	3h	3h
236	f	12	3h	3h	3h	4k	2q	4k	3j	4k	3h	2q	4k	3h	3h	3h	3h	4k	2q	4k	4k	4k	3h	4k	2q	3h	3h
237	f	12	2h	3h	3h	4k	2k	4k	3j	3h	3h	2h	3j	3h	3h	3j	3h	4k	2h	4k	4k	3j	3h	4k	2h	3h	3h
238	f	12	3h	3h	3h	4k	2x	4k	3h	3k	3h	2x	4k	3h	3h	3h	3h	4k	2h	4k	4k	4k	3h	4k	2x	3h	3h
239	f	12	3j	3h	3h	4k	2k	4k	3h	3k	3k	2g	3h	3h	3k	2g	3h	4k	2g	4k	4k	3h	3h	4k	2g	3h	3j
240	f	12	3h	3j	3h	4k	2k	4k	4k	3k	3h	2h	3h	3h	3h	2k	3h	4k	2h	4k	4k	3f	3h	4k	2g	3k	3h
241	f	12	3h	3h	3h	4k	2e	4k	3h	3k	3h	2a	3k	3h	3h	2a	3h	4k	2h	4k	4k	9k	3h	4k	2h	3h	3h
242	f	12	2g	3e	3h	4k	2h	4k	3h	3k	3h	2k	3k	3h	3h	2h	3h	4k	2k	4k	4k	3h	3h	4k	2h	3h	3h
243	f	12	3e	3e	3h	4k	2e	4k	3e	3k	3h	2k	3h	3h	3h	3h	3h	4k	2k	4k	4k	3e	3h	4k	2k	3h	3h
244	f	12	3h	3h	3h	4k	2k	4k	4k	4k	3h	2q	3h	3h	3h	3h	3h	4k	2a	4k	4k	4k	3h	4k	2a	3h	4k
245	f	12	1k	3k	3h	4k	2x	3k	2y	3k	3h	2x	3h	3h	3h	3h	3h	4x	2x	4k	4k	3f	3h	3h	2x	3h	3e
246	f	12	3h	3h	3h	4k	2o	4k	3h	3k	3h	2o	3h	3h	3h	3h	3h	4k	2o	4k	4k	3h	3h	4k	2o	3h	3h
247	f	12	3h	3h	3h	4a	2a	4k	9a	3k	3h	2a	3h	3h	3h	3h	3h	4k	2a	4k	4k	3h	3h	4k	2a	3h	3h
248	f	12	3h	3e	3h	4k	2o	4k	3e	3k	3h	2o	3h	3h	3h	3e	3h	3h	2o	4k	4k	3e	3h	4k	2o	3h	3e
249	f	12	3h	3h	3h	4k	2h	4k	3e	4k	3h	2k	3h	3h	3h	3h	3h	4k	2h	4k	4k	3j	3h	4k	2x	3h	3h
250	f	12	2q	3h	3h	4k	2h	4k	3h	4k	3h	2o	4k	3h	3h	2o	3h	4k	2o	4k	4k	3h	3h	4k	2o	3h	3h
251	f	12	3e	3h	3h	4k	2x	4k	3e	4k	3h	2x	3h	3h	3h	3e	3h	4k	2x	4k	4k	3h	3h	4k	2x	3h	3h
252	m	12	3h	3h	3h	4k	2q	4k	2q	3k	3h	2q	3h	3h	3h	2q	3h	4k	2q	4k	4k	3h	3h	4k	2q	3h	3h
253	m	11	3h	3h	3h	4k	2e	4k	3h	3k	3h	2e	3h	3h	3h	2q	3h	4k	2e	4k	4k	3h	3h	4k	2e	3h	3h
254	m	11	3j	3h	3h	4k	2o	4k	1a	3k	3h	2o	3h	3h	3h	2o	3h	4k	2a	4k	4k	9k	3h	4k	2o	3h	3h
255	m	11	3h	3h	3h	4k	2g	4k	3h	3k	3h	2g	3h	3h	3h	4k	3h	4k	2g	4k	4k	4k	3h	4k	2g	3h	3h
256	m	11	3h	3e	3h	4k	2q	4k	3e	3k	3h	2o	4k	3h	3h	3e	3h	4k	2o	4k	4k	4k	3h	4k	2o	3h	3h
257	m	11	4a	3e	3h	4k	2h	4k	4a	4k	3h	2a	4k	3h	3h	2a	3h	4k	2a	4k	4k	3e	3h	4k	2a	3h	3h
258	m	11	3h	3e	3h	4k	2a	4k	3e	4k	3h	2a	4b	3h	3k	3e	3h	4k	2a	4k	4k	4k	3h	4k	2a	3h	3e
259	m	11	3h	3e	3h	4k	2q	4k	3e	3k	3h	2q	3h	3h	3h	3e	3h	4k	2o	4k	4k	3e	3h	4k	2q	3h	3h
260	m	12	4k	4k	3h	4k	2k	4k	3j	4k	3h	2k	4k	3h	3h	4k	3h	4k	2k	4k	4k	4k	3h	4k	2k	3h	3h
261	m	11	2h	3h	3h	4k	2h	4k	2h	3k	3h	2h	3h	3h	3h	2h	3h	4k	2h	4k	4k	3j	3h	4k	2h	3h	3h
262	m	11	3h	3h	3h	4k	2k	4k	3h	4k	3h	2o	3h	3h	3h	2k	3h	4k	2k	4k	4k	3h	3h	4k	2k	3h	4k
263	m	11	2g	3f	3h	4k	2g	4k	2h	3h	3h	2h	3h	2h	3h	2h	3h	4k	2g	4k	4k	4g	3h	4k	2o	3h	3h
264	m	11	3h	3h	3h	4k	2g	4k	3j	4k	3h	2h	4k	3h	3h	2h	3h	4k	2h	4k	4k	4k	3h	4k	2h	3h	3h
265	m	11	2q	3k	3h	4k	2j	4k	4j	4k	3h	2j	3j	3h	3h	3j	3h	4k	2h	4k	4k	4j	3h	4k	2h	3h	4k
266	m	11	3h	3h	3h	4k	2h	4k	3h	3k	3h	2e	3h	3h	3h	2e	3h	4k	2e	4k	4k	4k	3h	4k	2j	3h	3h
267	m	11	3e	3e	3h	4k	2o	4k	1a	4k	3h	2h	3h	3k	3h	2o	3h	4k	2a	4k	4k	3h	3h	4k	2a	3h	3h
268	f	11	3h	3h	3h	4k	2o	4k	3h	3k	3h	2o	3h	3h	3h	3h	3h	4k	2o	4k	4k	3h	3h	4k	2o	3h	3h
269	m	11	4k	3h	3h	4k	2k	4k	3j	3k	3h	2k	3h	3h	3h	3j	3h	4k	2k	4k	4k	3h	3h	4k	2k	3h	4k

Appendix.8:Ab. Continued.

Stimulus B, Completion Task.

sub no.	sex	age	own		3	4	2	4		4	3	2		3	3		3	4	2	4	4		3	4	2	3	choice
270	m	10	4k	4k	3h	4k	2q	4k	4k	4k	3h	2k	4k	3h	3h	4k	3j	4k	2q	4k	4k	4k	3h	4k	2q	3h	4k
271	f	10	3h	3h	3k	4k	2k	4k	4k	3k	3k	2k	3h	3h	3h	3h	3k	4k	2k	4k	4k	4k	3h	4k	2k	3h	3h
272	m	10	2q	3h	3h	4k	2k	4k	4k	4k	3h	2q	4k	3q	3h	4k	3h	4k	2q	4k	4k	3h	3h	4k	2q	3h	3h
273	f	10	4k	3h	3h	4k	2k	4k	4k	4k	3h	2k	3h	3h	3h	2k	3h	4k	2k	4k	4k	3h	3h	4k	2k	3h	2h
274	f	10	2q	4k	3h	4k	2q	3k	2q	3k	3k	2g	4h	3h	3k	2q	3e	2q	2q	4k	4k	4k	3h	4k	2q	3h	2q
275	m	10	2q	3h	3h	4g	2g	4k	2g	4k	3h	2g	3k	3h	3h	2g	3j	3g	2o	4k	4k	3j	3j	4k	2h	3h	3h
276	m	10	6o	3h	3h	4k	3h	4k	3h	4k	3h	3h	4k	3e	3h	3h	3h	4k	3h	4k	4k	3h	3h	4k	2o	3h	3h
277	f	10	3h	4k	3k	4k	4k	4k	3h	4k	3h	2k	3h	3h	3h	4k	3h	4k	2k	4k	4k	·3h	3h	4k	2k	3h	3h
278	m	10	3j	3j	3h	4k	2k	4k	3j	3k	3h	2k	3j	3j	3h	2k	3j	4k	2k	4k	4k	3j	3j	4k	2g	3h	3h
279	f	10	2k	4k	3h	4k	2k	4k	4k	4k	3h	2k	4k	3h	3h	4k	3j	4k	2k	4k	4k	3h	3h	4k	2k	3h	3h
280	m	10	3f	4k	3h	4k	2k	4k	3h	4k	3h	2l	4k	3f	3k	4k	3f	4g	2q	4k	4k	4g	3f	4g	2j	3k	3h
281	f	10	2k	4k	4k	4k	2k	4k	2k	4k	3k	2k	4k	3k	3h	2k	3k	4k	2k	4k	4k	3k	3e	4k	2k	3k	3h
282	m	10	2k	4k	3k	4k	2k	4k	2k	9k	3h	2o	9k	3k	3k	2o	3k	4k	2k	4k	4k	4k	3k	4k	2k	3h	3h
283	m	10	2k	3h	3h	4k	2k	4k	2k	3k	3h	2k	3h	3h	3h	2k	3h	4k	2k	4k	4k	3h	3h	4k	2k	3h	3h
284	f	10	4a	4a	3k	4a	2a	4k	4a	4k	3k	2a	3k	3h	3h	4a	3h	4a	2a	4k	4k	4a	3e	4a	2a	3k	3h
285	f	10	3h	3h	3h	3h	3h	4k	3h	3k	3h	3h	3h	3h	3h	3h	3h	4h	2h	4k	4k	4h	3h	4h	2h	3h	3h
286	m	9	2k	4k	4k	4k	2k	2k	2k	4k	3h	2k	2k	3k	3k	2k	3k	4k	2k	4k	4k	3k	3k	4k	2k	3k	3k
287	f	9	4k	3h	3h	4k	3h	4k	3h	4k	3h	2q	4k	3h	3h	3h	3h	3h	2q	4k	4k	3e	3h	3h	2q	3h	3h
288	m	9	9a	9a	3a	4a	2a	4a	2a	9a	3a	2a	9a	3a	3h	2a	3a	4a	2a	4a	4a	9a	3a	4a	2a	3a	4a
289	f	9	2h	3a	3h	4k	2o	4k	2o	3k	3h	2k	9a	3o	3h	2o	3o	4o	2k	4k	4k	9k	3k	4o	3o	3h	3h
290	f	9	2l	3k	3h	4l	2x	4k	2x	4k	3h	2x	4k	2x	3h	2x	3j	4x	2x	4k	4k	3j	3x	4x	2x	3h	3h
291	f	9	2k	4k	3k	4k	2k	4k	3k	4k	3h	2k	4k	3g	3h	2k	3a	4g	2k	4k	4k	3k	3l	4k	2k	3h	4k
292	m	9	3h	3k	3k	4g	2g	4k	2h	4k	3h	2k	3k	3h	3k	2h	3j	4g	2q	4k	4k	3j	3j	4g	2q	3k	4k
293	f	9	2k	3g	3f	4a	2k	4k	2k	4l	3h	2k	9k	3k	3h	2k	3k	4k	2k	4k	4k	9k	3k	4k	2o	3k	3h
294	m	9	3h	3h	3h	4a	4a	4a	3h	3k	3k	2o	3a	4o	3k	1a	3o	4a	2q	4k	4k	4k	3l	4o	2o	3h	3h
295	m	9	3h	3h	3h	4k	2l	3k	2a	3k	3h	2a	3h	2a	3h	2a	3e	3e	2a	4k	4a	4a	3e	3e	2a	3h	3h
296	f	9	2g	4k	3k	4k	2k	4k	2k	4k	3k	2k	9k	3k	3k	2k	3k	4k	2k	4k	4k	4k	3k	4k	2k	3k	3k
297	m	9	2g	4k	3k	4k	2k	4k	2g	4k	3k	2k	3k	2k	3k	2k	4k	4k	2k	4k	4k	4k	3k	4k	2k	3k	3k
298	m	9	3h	3h	3h	4k	2k	4k	3j	4k	3h	2k	3h	2k	3h	3h	3h	4k	2k	4k	4k	3h	3h	4k	2k	3h	4k
299	f	9	2e	3e	3h	4a	2h	4k	2a	3k	4h	2h	3h	2l	3h	2h	3h	4a	2e	4k	4k	3h	3e	3e	2e	3h	3k
300	m	9	3h	4k	3h	4k	2k	4k	3j	4k	3h	2k	3h	3h	3h	4k	3h	4k	2k	4k	4k	4k	3j	4k	2k	3h	3h
301	f	9	4g	4k	3h	4k	2k	4k	4k	4k	3h	2g	4k	3h	3h	2k	3h	4k	2k	4k	4k	4k	3h	4k	2g	3h	3h
302	m	8	3h	3h	3h	4k	2q	4k	2q	4k	3h	2q	3j	3f	3h	2q	3q	4k	2q	4k	4k	3q	3q	4k	2q	3h	3h
303	m	8	2l	3h	3h	4k	2q	4k	2k	4k	3h	2k	4k	3k	3h	2h	3j	4k	2l	4k	4k	3h	3h	4k	2h	3h	3h
304	m	8	2v	3g	3k	4g	2v	4k	2v	4k	3h	2v	4k	2v	3h	2v	3j	2v	2v	4k	2v	3v	3v	4v	2v	3h	3h
305	m	8	3l	3i	3h	4k	2x	4k	2x	3k	3h	2x	3i	3i	3h	3l	3i	4k	2a	4k	4k	3l	3l	4k	2x	3h	3h
306	f	8	2k	3k	3k	4k	2k	4k	2k	3k	3k	2k	3k	2k	3k	2k	3k	3k	2k	4k	4k	3k	3k	4k	2k	3k	4k
307	m	8	3f	4a	3f	4g	2g	4g	2g	4g	3f	2g	4g	3f	3f	2g	3f	4g	2g	4g	4g	4g	3f	4g	2g	3f	3f
308	f	8	2g	4g	3k	4g	2g	4k	2g	4k	3k	2g	3k	3g	3h	2h	3g	4g	2g	4k	4k	3l	3l	4g	2g	3h	3h
309	f	8	2g	3h	3h	4k	2h	4k	2l	3k	3h	2h	4k	3j	3h	2k	3h	4k	2l	4k	4k	3g	3f	4g	2l	3h	3h
310	f	8	2k	3h	3h	4k	2k	4k	3k	3k	3h	2k	3k	3k	3h	2k	3k	4k	2k	4k	4k	4k	3k	4k	2k	3h	3h
311	m	8	2l	4g	3j	4a	2l	4g	2l	4g	3j	2g	4g	2g	3j	2g	3g	4g	2g	4g	4g	4g	3g	3g	2g	3j	3j
312	m	8	2h	3a	3h	4g	2v	4k	2h	4k	3h	2g	3k	3g	3h	2g	3k	4k	2g	4k	4k	4k	3k	4k	2g	3h	3h
313	m	8	3h	3f	3h	4g	2v	4k	2a	4k	3h	2v	3h	3h	3h	3h	3h	4k	2v	4k	4k	4k	3j	4k	2v	3h	3j
314	m	7	2v	3l	3h	4v	2v	4k	2o	4k	3h	2a	3k	3a	3h	2a	3a	4a	2a	4k	4k	3a	3a	4a	2a	3h	3h
315	f	7	2v	3l	3h	4v	2g	4k	2g	4k	3k	2k	4k	2g	3k	2g	3g	3g	2g	4k	4k	4g	3g	3g	2k	3k	3k
316	m	7	2v	4k	3h	4x	2x	4k	2x	4k	3h	2v	4k	2v	3h	2x	3x	4k	2x	4k	4k	4k	3l	4k	2x	3h	3h
317	m	7	2v	3k	3h	4x	2x	3k	2x	3k	3h	2x	3h	2x	3h	2x	3x	3x	2x	4k	4k	3x	3x	3x	2x	3h	3h
318	f	7	2k	3k	3k	4g	2l	4k	4k	4k	3k	2k	4k	2l	3k	2l	3k	4g	2l	4k	4k	4k	3l	4l	2l	3k	3k
319	m	7	1a	9g	3a	4g	2a	4k	1a	9a	3e	2a	9a	2a	2a	2a	3a	3a	2a	9a	4a	9a	3g	3a	2a	3a	3e
320	m	7	2h	4k	4k	4k	2h	4k	2k	4k	3h	2h	4k	3h	3h	3e	3f	4k	2f	4k	4k	3f	3h	4k	2h	3h	3h

Appendix.8:Ab. Continued.

Stimulus 8. Completion Task.

own no.	sex	age	own		3	4	2	4		4	3	2		3	3		3	4	2	4	4		3	4	2	3	choice
321	m	7	2v	31	3h	4v	2v	31	2v	31	3h	2v	31	3x	3h	2v	3h	4v	2v	4k	4k	3o	3a	4a	2a	3h	3h
322	f	7	2v	4v	3f	4a	21	4g	21	4g	3h	2v	4g	2v	3f	21	4v	4v	2v	4g	4g	4v	31	41	21	3f	3f
323	f	7	2k	3a	3h	4a	2o	4k	2o	4k	3h	2o	4k	3o	3h	2o	3o	4o	2k	4k	4k	3o	3k	4o	2o	3h	3h
324	f	7	1a	4a	3h	4a	2a	4g	2v	4g	3f	2v	4g	2a	3h	2v	3x	4v	2v	4g	4v	4v	3v	4v	2v	3h	3h
325	m	7	2g	3g	3f	4g	2g	4k	2g	4k	3h	2g	4k	3g	3h	2g	3g	4g	2g	4k	4k	4g	3g	4g	2g	3h	2g
326	m	6	31	3a	3h	4a	2a	4k	2k	4k	3h	2a	4k	3g	3h	2a	3g	4a	2k	4k	4a	4g	3g	4g	2g	3g	2a
327	f	6	2a	2a	3h	4g	2a	4k	2a	4k	3h	2a	4k	2a	3h	2a	3a	3a	2a	4k	4k	3a	3a	3a	2a	3h	3h
328	m	27	3h	3h	3h	4k	2a	4k	3h	4k	3h	2a	3h	3h	3h	3h	3e	4k	2a	4k	4k	3e	3e	4k	2a	3h	3h
329	m	36	3h	3h	3h	4k	2o	4k	3e	4k	3h	2o	3h	3h	3h	1a	3h	4k	2o	4k	4k	3h	3h	4k	2o	3h	4k
330	f	9	3h	3h	3h	4h	4h	4h	4h	4h	3h	3h	4h	4h	3h	3h	3h	4h	2h	4h	4h	4h	3h	4h	4h	3h	3h
331	f	7	2h	3h	3h	4k	2g	4k	2g	4k	3h	2g	3k	3f	3h	2g	3f	4g	2g	4k	4k	3j	3j	4g	2g	3h	3h
332	f	8	3k	3k	3h	4k	2k	4k	3k	3k	3h	2k	3k	3h	3h	4k	3f	4k	2k	4k	4k	3k	3f	4k	2k	3h	3h
333	f	8	4k	2x	4k	4k	2x	4k	2x	4x	3h	2x	4x	2x	3f	2x	4x	4x	2x	4k	4k	2x	3z	4x	2x	3h	3h
334	f	9	3h	4k	3h	4k	2a	4k	4k	4k	3k	2o	4k	2a	3k	21	31	4k	2k	4k	4k	4k	31	4k	2a	3h	3h
335	f	10	2k	4k	3k	4g	2a	4k	3j	4k	3h	2a	4k	3k	3h	21	3j	3j	2j	4k	4k	4k	3j	4a	2k	3h	3h
336	m	23	3h	3h	3h	4k	4k	4k	3j	4k	3h	2o	3h	3h	3h	3h	3h	4k	2o	4k	4k	3h	3h	4k	2o	3h	3h
337	m	16	3j	3e	3h	4k	2a	3k	3e	3k	3h	2a	3j	3e	3h	3h	3e	3e	2a	4k	4k	3e	3e	3e	2a	3h	3h
338	m	17	3h	3e	3h	4k	2k	4k	3j	3k	3h	3h	3j	3h	3h	3j	3j	4k	2o	4k	4k	3j	3j	4k	2a	3h	3e
339	f	7	2k	4k	3k	4k	2k	4k	2k	4k	3k	2k	4k	2k	3k	2k	4k	3k	2k	4k	4k	4k	3k	4k	2k	3h	3h
340	m	31	6k	3h	3h	4k	2o	4k	1a	4k	3h	2o	3h	3h	3h	3h	3e	3h	2o	4k	4k	3h	3h	4k	1a	3h	3h
341	m	17	3e	3h	3h	4a	2q	4k	2q	4k	3h	2q	3h	3e	3k	4k	3h	3h	2k	4k	4k	3e	3h	4k	2q	3h	4k
342	f	17	3e	3h	3h	4k	2a	4k	3e	4k	3h	2h	3h	3e	3h	3h	3h	4k	2a	4k	4k	4k	3h	4k	2a	3h	3h
343	m	17	3h	3h	3h	4k	2a	4k	3h	3k	3h	2o	3h	3h	3h	3h	3h	4k	2o	4k	4k	3h	3h	4k	2o	3h	3h
344	m	18	3h	3h	3h	4k	2a	4k	3e	3h	3h	2a	3h	3o	3h	3e	3e	4a	2a	4a	4k	3e	3e	4a	2a	3h	3h
345	m	17	3h	3e	3h	4k	2a	4k	3h	4k	3h	2a	3h	3h	3h	3h	3h	4k	2a	4k	4k	3h	3h	4k	2a	3h	3h
346	f	17	2h	3h	3h	4k	2g	3k	21	3k	3h	21	3h	3j	3h	3j	3j	4k	21	4k	4k	3h	3h	4k	21	3h	3h
347	m	54	4k	4k	3h	4k	2o	4k	4k	4k	3h	2o	4k	3h	3h	4k	3h	4k	2o	4k	4k	3h	3h	4k	2o	3h	4k
348	f	24	3h	3h	3h	4k	2o	4k	3h	4k	3h	2o	3h	3h	3h	3h	3h.	4k	2o	4k	4k	3h	3h	4k	2o	3h	3h

Appendix.8:Ac. The raw data obtained on Stimulus sheets W, X, Y and Z.

Stimulus W, Completion Task.

sub no.	sex	age						own	choice
349	m	4	4a	3e	2x	4k	3f	2a	2a
350	m	4	4g	3g	1g	2k	-	2v	3g
351	m	4	4g	3g	1g	4k	-	2g	3g
352	m	4	4a	3e	1a	4k	3h	1a	3h
353	m	4	4a	3a	1v	-	-	2g	3a
354	f	4	4y	3y	1a	4y	-	2a	2a
355	f	4	4a	3v	1a	2k	-	2v	3v
356	f	5	4g	4g	2a	4g	3g	2o	3g
357	f	5	4r	3a	-	-	-	2a	3a
358	m	5	4g	3o	-	-	-	2b	2b
359	m	5	4b	3c	2a	2g	3g	2b	3g
360	m	5	4a	3h	4a	2k	3h	1a	3h
361	f	5	4a	3a	2r	4k	3g	2a	2a
362	f	5	4a	3x	2r	4a	[illegible]	2a	3x
363	f	5	4a	3f	4a	2k	3e	1a	3e
364	f	5	4k	3k	2k	4k	3j	2k	3j
365	f	5	4x	3y	-	4a	3h	2g	3h
366	m	5	4g	3g	4g	4g	3f	1a	4g
367	m	6	4k	3j	1a	2k	3h	4g	3h
368	m	6	4a	3c	1a	4k	3j	1a	3j
369	f	6	4v	3x	2y	4g	3j	1g	3j
370	m	6	4g	3f	2a	4g	3f	1a	3f
371	f	6	4a	3j	2k	2k	3f	1a	3f
372	m	6	4g	3v	1a	2k	3j	1a	2k
373	m	7	4g	3j	2x	4k	3h	2g	3h
374	m	7	4r	3e	1a	2k	3h	2a	3h
375	m	7	4a	3j	1a	4k	3h	1g	3h
376	f	7	4g	3g	1a	2g	-	1a	3g
377	m	7	4b	3n	1g	4g	3j	1g	3j
378	m	7	4g	3f	1g	2g	3j	1a	3j
379	f	7	4v	3e	4g	2g	3j	2g	3j
380	m	8	4k	3j	1a	4k	3h	2a	3h
381	f	8	4k	3n	2a	4k	3h	3x	3h
382	f	8	4a	3f	4a	4g	3f	2k	3f
383	m	8	4g	3f	2g	2k	3h	1a	3h
384	f	8	4k	3f	2g	2k	3f	2k	3h
385	m	8	4k	3g	2k	2k	3h	3e	3e
386	f	8	4h	3h	3e	3k	3h	3e	3h
387	m	8	2g	3v	1a	4k	3j	1g	3j
388	f	9	4k	3h	2g	2k	3h	2a	3h
389	m	9	4o	3o	1a	1a	3f	2h	3f
390	f	9	4j	3h	2g	2k	3f	2g	3h
391	m	9	4k	3h	3h	4k	3h	3j	3h
392	m	9	4g	3g	2g	4k	3h	2g	2g
393	m	9	4k	3j	3h	4k	3h	1a	3h
394	f	9	4x	3x	2x	2k	3f	2h	3f
395	f	10	4k	3j	2x	4k	3h	2j	3j
396	m	10	4a	3h	1a	4k	3h	2a	3h
397	f	10	4k	3j	2x	4k	3h	2k	3h
398	f	10	4k	3j	1g	4k	3h	3j	3h
399	f	10	4k	3h	2x	4k	3h	2v	3h

Stimulus X, Completion Task.

sub no.	sex	age						own	choice
400	f	4	4a	3g	2a	4k	3h	2a	3h
401	f	4	4g	3g	2g	4k	2g	2g	2g
402	m	4	4a	3a	4a	4k	2h	1a	4a
403	f	4	4g	3v	2r	4k	2d	1a	3v
404	m	4	4g	3f	2a	4k	2h	2g	3f
405	f	4	4g	3g	2g	-	-	1a	3g
406	m	4	4a	3v	2g	4k	3j	-	3j
407	m	5	4a	3e	4r	4k	3h	1a	3h
408	f	5	4a	3c	4a	4k	2h	1a	3c
409	f	5	4g	3g	4a	-	3h	1g	3h
410	f	5	4a	3a	4g	4b	3g	1b	3g
411	m	5	4a	3j	4a	4k	2h	1a	3j
412	m	5	4a	3e	3a	4k	2h	1a	3a
413	m	6	4a	3c	4a	4g	2h	1a	1a
414	m	6	4x	3x	2a	4k	3h	1g	3h
415	f	6	4a	3a	3a	4k	2h	2v	4k
416	f	6	4a	3a	3a	4k	3j	2a	3j
417	m	6	4k	3h	2a	4k	3h	1g	3h
418	f	6	4k	3x	4a	4k	2h	1g	2h
419	f	6	4a	3e	4g	4g	3h	2g	3h
420	f	6	4a	3e	4a	4k	2g	1a	3e
421	f	7	4a	3a	4a	4g	3h	2g	3h
422	m	7	4g	3j	4a	4k	2h	2g	3j
423	f	7	4g	3x	4a	4k	3h	2g	3h
424	m	7	4g	3g	4a	4k	2h	2g	2h
425	f	7	4v	3v	3g	4k	2h	2g	3g
426	m	7	4a	3h	4a	4k	3h	2a	3h
427	m	7	4a	3h	4a	4k	3h	1a	3h
428	m	7	-	-	4a	4k	3h	2h	3h
429	m	8	4k	3e	3f	4k	3h	2g	3h
430	f	8	4a	3e	4a	4g	2h	2k	3e
431	f	8	4a	3e	4a	4k	3h	2g	3h
432	m	8	4k	3c	4k	4k	3h	1g	3h
433	m	8	4k	3h	3j	4k	3h	2g	3h
434	m	8	4k	3j	4k	4k	3h	2g	3h
435	f	8	4k	3j	4k	4k	3h	4k	3h
436	f	8	4k	3j	3k	4k	3h	3h	3h
437	m	9	4k	3h	4a	4k	3h	2g	3h
438	m	9	-	-	4k	4k	3h	3h	3h
439	f	9	4k	3h	2k	4k	3h	3h	3h
440	f	9	4k	3h	3g	4k	2h	2e	3h
441	m	9	4g	3v	1a	4k	2h	1g	2h
442	m	9	4k	3f	3f	4k	3h	3f	3h
443	f	9	4k	3h	4a	4k	3h	3j	3h
444	m	10	4k	3j	3j	4k	3h	1k	3h
445	m	10	4k	3g	3g	4k	3h	2g	3h
446	f	10	4x	3x	3x	4k	2h	2v	3x
447	f	10	4k	3h	3e	4k	3h	3j	3h
448	m	10	4g	4f	4g	4k	3h	1a	3h
449	f	10	4k	3h	4a	4k	3h	2g	3h
450	m	10	4x	3x	4a	4k	3h	2v	3h
451	f	10	4k	3j	4k	4k	3h	2k	3h
452	f	10	4g	3g	3f	4g	3g	3j	3j

Appendix.8:Ac. Continued.

Stimulus Y, Completion Task.

no.	sex	age						own	choice
453	f	4	4g	3g	4c	4k	3h	1a	3h
454	f	4	4x	3x	-	2k	-	1a	3x
455	m	4	4g	3g	4d	4k	3h	2g	3h
456	m	4	4a	3x	4g	4k	3h	1a	3h
457	m	4	4k	3k	2b	2k	2c	1a	3k
458	f	4	4b	3x	4b	4k	3h	2g	3h
459	f	4	4g	3x	4d	4k	3j	1g	3j
460	f	4	4a	3v	4d	2k	3h	2a	3h
461	f	4	4a	3v	4d	4k	3h	2g	3h
462	m	5	4a	3v	-	-	-	1g	4a
463	m	5	4g	3g	4b	4k	3h	2g	3h
464	f	5	4g	3g	4b	4k	3h	2g	3h
465	m	5	4g	3g	4b	2k	3h	2g	3h
466	f	5	4v	3v	2d	2k	3f	2g	2k
467	f	5	-	3g	4b	4g	3b	2g	3g
468	f	5	4a	3b	4x	4k	3f	2g	4a
469	m	5	4a	3a	1g	4g	3g	1a	3g
470	m	6	4a	3x	4x	2k	3j	2a	3j
471	m	6	4g	3n	4g	4g	3j	1a	3j
472	f	6	4g	3f	4h	3k	3h	2n	3h
473	f	6	2v	3x	4g	3k	3h	2a	3h
474	m	6	4d	3e	4g	4k	3j	1a	3j
475	m	6	4n	3j	3f	3k	3h	3j	3h
476	f	6	4a	3x	3b	2k	3h	1g	3h
477	f	7	4g	3g	4k	4k	3h	2g	3h
478	f	7	4a	3f	[illegible]	[illegible]	3h	1g	3h
479	f	7	4a	3x	4d	4k	3h	1a	3h
480	m	7	4g	3g	3g	4g	3j	2g	3j
481	m	7	4g	3x	3g	4k	3h	1g	3h
482	m	7	2k	3g	3g	3f	3h	1g	3h
483	f	7	4a	3j	4k	4k	3h	2k	3h
484	f	7	4k	4k	4g	4k	3h	1a	3h
485	f	7	4v	3x	4b	3k	3h	2a	3h
486	f	8	4g	3j	4k	4k	3h	2k	3h
487	f	8	4a	3f	4a	4a	3h	2k	3h
488	m	8	4k	3h	4k	4k	3h	1g	3h
489	m	8	4g	3f	3f	2k	3h	2g	3h
490	m	8	4k	3h	4k	4k	2g	2k	3h
491	m	8	4g	3h	3k	4k	3h	3j	3h
492	f	8	4g	3n	4a	4a	3f	2g	3f
493	f	8	4k	3x	4d	2k	3h	2g	3h
494	f	9	4a	3j	2a	2g	3h	2g	3h
495	m	9	4g	3f	3f	3k	3h	1a	3h
496	f	9	4k	3j	4k	4k	3h	2a	3h
497	f	9	4x	3x	4x	4k	3h	2v	3h
498	m	9	4c	3h	4c	4k	3h	1a	3h
499	m	9	4k	3h	3h	3k	3h	1g	3h
500	m	9	4a	3f	3j	4k	3h	2h	3h
501	m	9	4g	3j	3j	2k	3h	2g	3h
502	m	10	4g	3h	4k	4k	3h	3j	3h
503	m	10	4k	3h	3f	4k	3h	3e	3h
504	m	10	4k	3h	3h	4k	3h	1a	3h
505	m	10	4k	3h	4k	4k	3h	1g	3h
506	f	10	4k	3f	3g	2k	3h	2h	3h
507	f	10	4k	3j	3c	3k	3h	2x	3h
508	f	10	4g	3j	4k	4k	3h	2g	3h
509	m	10	4k	3h	3h	4k	3h	2a	3h

Stimulus Z, Completion Task.

no.	sex	age						own	choice
510	f	4	4k	3h	4k	4k	3h	2a	3h
511	m	4	4a	3a	-	-	-	2b	3a
512	f	4	4g	3g	2k	-	3h	2a	3h
513	f	4	4v	3r	3k	-	3h	2g	3h
514	m	4	-	-	-	-	-	2x	2x
515	m	4	4r	3v	4k	4k	3h	1a	3h
516	m	4	4k	3x	2k	1k	3h	1a	3h
517	m	5	4a	3a	2k	-	3h	2a	3h
518	f	5	4a	3a	4g	4g	3f	1a	3f
519	f	5	4a	3a	-	4g	3h	1a	3h
520	m	5	4a	3g	4k	1k	3h	1a	3h
521	m	5	4g	3x	4k	1k	3j	1a	3j
522	m	6	4a	3f	2k	1k	3h	2f	3h
523	m	6	4a	3x	4k	4k	3h	2a	3h
524	m	6	4g	3x	4k	4k	3h	2g	3h
525	f	6	4v	3v	2k	4k	3h	2g	3h
526	m	6	4a	3x	4k	4k	3h	1g	3h
527	f	6	4x	3x	4k	-	3h	1a	3h
528	f	6	4x	3e	4k	4k	3h	1a	3h
529	f	6	4r	-	3a	[illegible]	3h	2a	3h
530	f	6	4a	3a	4k	4k	3h	1a	3h
531	f	7	4k	3j	4k	4k	3h	2g	3h
532	m	7	4x	3x	3k	4k	3h	2v	3h
533	m	7	4g	3h	3a	4a	3j	2g	3h
534	m	7	4y	3a	2g	2g	3j	1a	2g
535	f	7	2h	-	4k	4k	3j	2g	3j
536	f	7	4k	3h	4k	4k	3h	2k	3h
537	m	8	4a	3e	4g	4g	3f	2a	3e
538	f	8	4k	3j	4k	4k	3h	1b	3h
539	m	8	4a	3y	2k	4a	3e	1g	3e
540	f	8	4x	3f	4a	4a	3h	2h	3h
541	f	8	4g	3h	4k	4k	3h	2h	3h
542	m	8	4a	3h	4g	4g	3h	1g	3h
543	m	9	4g	3j	4k	4k	3h	3j	3h
544	m	9	4k	3j	3k	4k	3h	1k	3h
545	m	9	4k	3k	3k	4k	3j	2g	3j
546	m	9	4d	3e	3a	4a	3j	1g	3j
547	f	9	4k	3h	3a	[illegible]	3h	2g	3h
548	m	9	4k	3f	4k	4k	3h	2h	3h
549	m	9	4a	3j	4k	4k	3h	3f	3h
550	f	9	4a	3h	4a	4a	3h	1a	3h
551	m	10	4g	3j	4a	4a	3h	2g	3h
552	f	10	4k	3h	4k	4k	3h	4k	3h
553	f	10	4e	3e	4k	4k	3h	2v	3h
554	f	10	4k	3h	4k	4k	3h	1a	3h
555	f	10	4a	3h	3k	4k	3h	3j	3h
556	m	10	4a	3e	4k	4k	3h	2e	3h
557	m	10	4k	3h	4k	4k	3h	1k	3h
558	m	10	4k	3h	4k	4k	3h	3j	3h

Appendix 8:B.

Statistical tests indicating that the data should be amalgamated.

This appendix contains a series of statistical analyses, performed to investigate the possibility of significant differences in the data attributable to sex of subject, positional bias, and type of stimulus sheet. These investigations failed to find any significant differences that were attributable to these measures, and so the data were amalgamated.

Appendix 8:B.

Statistical tests showing little difference between stimuli.

Sex. χ^2 tests failed to find any significant sex differences in the proportions of response, with type of table top, drawn for stimulus C[17] (χ^2 = 1.7, df = 3, p > 0.5). This stimulus was chosen because it allowed a wide range of response. Examination of the raw data suggested that if any variation with sex was to be found it would show in the responses for ten year olds, however a similar test, just for this age group, also failed to show any significant differences (χ^2 = 0.1, df = 2, p > 0.9).

Within Sheet. Within sheet variation was examined by looking at the proportions of correct (ie in perspective) responses, with age, for stimulus G[21], on the second stimulus sheet given to the older subjects, where G[21] was included twice. A Kχ^2 test failed to find any significant differences between the two presentations (Kχ^2 = 0.03, df = 2, p > 0.05).

Between sheets, older subjects. Between sheet variation was examined by looking at proportions of responses in different projections as specified below, with age, for various stimuli, as specified below, across the two sheets given to the older subjects. The stimuli chosen for comparison were those that gave most chance of variation, however χ^2 tests failed to find any significant differences between the two sheets (Stimulus D[23]: oblique response, χ^2 = 5.1, df = 9, p > 0.05; perspective response, χ^2 = 10.3, df = 9, p > 0.05; Stimulus D[5]: oblique response, χ^2 = 4.3, df = 9, p > 0.05; perspective response, χ^2 = 4.4, df = 3, p > 0.05; Stimulus D[8]: oblique response, χ^2 = 4.6, df = 9, p > 0.05; perspective response, χ^2 = 6.5, df = 9, p > 0.05; Stimulus C[12]: vertical oblique response, χ^2 = 3.3, df = 7, p >0.05; oblique response, χ^2 = 2.8, df = 7, p > 0.05; perspective response, χ^2 = 6.6, df = 7, p > 0.05; Stimulus C[17]: vertical oblique response, χ^2 = 5.2, df = 9, p >0.05; oblique response, χ^2 =

9.5, df = 9, $p > 0.05$; perspective response, $\chi^2 = 1.5$, df = 7, $p > 0.05$; Stimulus A[6](own): vertical oblique, $\chi^2 = 3.9$, df = 7, $p > 0.05$, oblique response, $\chi^2 = 4.1$, df = 8, $p > 0.05$; perspective response, $\chi^2 = 7$, df = 8, $p > 0.05$; Stimulus B[25](choice): oblique response, $\chi^2 = 6.8$, df = 9, $p > 0.05$; perspective response, $\chi^2 = 4$, df = 8, $p > 0.05$)

Between sheets, younger subjects.

These were compared across the two common tasks that gave most variation, namely, choice, and own production. In each case the proportion of oblique response with age was chosen for the comparison. Stimulus B[25](choice):- W vs. X: $K\chi^2 = 0.2$, df = 2, $p > 0.05$; W vs. Y: $K\chi^2 = 0.05$, df = 2, $p > 0.05$; W vs. Z: $K\chi^2 =).46$, df = 2, $p > 0.05$; X vs. Y: $K\chi^2 = 0.21$, df = 2, $p > 0.05$; X vs. Z: $K\chi^2 = 0.21$, df = 2, $p > 0.05$; Y vs. Z: $K\chi^2 = 0.21$, df = 2, $p > 0.05$. Stimulus A[6](own):- W vs. X: $K\chi^2 = 3.33$, df = 2, $p > 0.05$; W vs. Y: $K\chi^2 = 1.12$, df = 2, $p > 0.05$; W vs. Z: $K\chi^2 = 4.19$, df = 2, $p > 0.05$; X vs. Y: $K\chi^2 = 1.76$, df = 2, $p > 0.05$; X vs. Z: $K\chi^2 = 1.04$, df = 2, $p > 0.05$; Y vs. Z: $K\chi^2 = 1.75$, df = 2, $p > 0.05$.

Between subject groups.

Different experimental methods were used with older and younger subject groups. Subjects of seven to ten years of age were included in both groups in order to investigate whether the different methods of presentation had an effect upon the form of response. The patterns of responses obtained for four stimuli (A6 [own], B25 [choice], F22, and G3) were compared using a series of $K\chi^2$ tests. These tests failed to find any significant differences between the two subject groups in the patterns of response, with age, to these stimuli. Stimulus A6 [own]:- Orthographic: $K\chi^2 = 2.12$, df = 2, $p > 0.05$; Vertical oblique: $K\chi^2 = 0.36$, df = 2, $p > 0.05$; Oblique: $K\chi^2 = 0.01$, df = 2, $p > 0.05$; Perspective: $K\chi^2 = 0.59$, df = 2, $p > 0.05$. Stimulus B25[choice]:- Oblique: $K\chi^2 = 0.56$, df = 2, $p > 0.05$. Stimulus F22:- Oblique: $K\chi^2 = 0.88$, df = 2, $p > 0.05$. Stimulus G3:- Perspective: $K\chi^2 = 0.6$, df = 2, $p > 0.05$.

A $K\chi^2$ test did find significant difference between the two groups of subjects when the total responses, amalgamated across the seven to ten age groups, were compared for Stimulus A6[own] ($K\chi^2 = 15.94$, df = 2, $p < 0.001$). The 'younger' subjects group, who had been given the shortened version of the stimuli, produced significantly more orthographic and fewer perspective responses, in total, than did subjects from the other group who had received the full battery of stimuli.

Appendix 8: C.

Amalgamated data giving proportions of response for each age group, for each individual stimulus.

The amalgamated data discussed in Chapter 8 are presented in this appendix. The first part of the appendix gives, for each stimulus, the proportions of response, with age, classified in full by the system described in Chapter 6. The second part of the appendix gives the same data classified according to the projection system used. The third part presents the data classified according to the form of depth cue used.

Appendix 8:Ca. Analysis of amalgamated data, classified in detail by form of response, stimulus and age.

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Table A. % Responses against age for columns 1-25

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Column 1 Perspective Response expected.

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	6.3	15.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1a	0.0	0.0	0.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2s	0.0	5.3	0.0	7.3	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2k	31.3	21.1	27.8	4.9	11.4	9.4	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3f	0.0	0.0	0.0	2.4	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3s	0.0	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	6.3	2.9	5.3	2.9	10.0
3k	0.0	0.0	16.7	4.9	4.5	13.2	12.5	0.0	3.3	3.1	0.0	0.0	11.4	5.0
3p	0.0	0.0	0.0	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4a	0.0	10.5	0.0	2.4	4.5	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4s	0.0	21.1	16.7	9.8	15.9	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4h	0.0	0.0	0.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4k	56.3	26.3	33.3	63.4	59.1	64.2	85.1	100.0	93.3	90.6	97.1	94.7	85.7	85.0
4x	0.0	0.0	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4y	6.3	0.0	0.0	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix 8:Ca. Continued.

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Column 2 = Vertical oblique response expected.

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2a	0.0	0.0	60.0	12.0	10.7	7.9	8.6	7.1	13.3	15.6	29.4	42.1	25.7	30.0
2e	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	6.7	6.3	2.9	5.3	0.0	0.0
2g	0.0	0.0	20.0	16.0	17.9	15.8	14.3	10.7	0.0	0.0	0.0	2.6	2.9	0.0
2h	0.0	0.0	0.0	4.0	3.6	2.6	0.0	10.7	23.3	3.1	2.9	0.0	0.0	0.0
2j	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	0.0	9.4	0.0	0.0	0.0	0.0
2k	0.0	0.0	0.0	20.0	25.0	52.6	51.4	21.4	26.7	40.6	26.5	23.7	8.6	0.0
2p	0.0	0.0	0.0	8.0	7.1	2.6	8.6	0.0	0.0	0.0	0.0	0.0	5.7	0.0
2q	0.0	0.0	0.0	0.0	7.1	0.0	5.7	14.3	13.3	15.6	17.6	5.3	22.9	10.0
2r	0.0	0.0	0.0	8.0	3.6	2.6	0.0	25.0	6.7	0.0	0.0	10.5	22.9	45.0
2v	0.0	0.0	0.0	12.0	10.7	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0
2x	0.0	0.0	20.0	16.0	10.7	7.9	2.9	0.0	10.0	6.3	0.0	0.0	2.9	0.0
3e	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0
3h	0.0	0.0	0.0	0.0	0.0	2.6	5.7	0.0	0.0	0.0	2.9	10.5	2.9	10.0
3j	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	0.0	0.0	2.9	0.0
3k	0.0	0.0	0.0	4.0	0.0	0.0	0.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0
4a	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4h	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0
4k	0.0	0.0	0.0	0.0	3.6	0.0	2.9	0.0	0.0	0.0	11.8	0.0	2.9	0.0

Appendix 8:Ca. Continued.

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Column 3 Perspective response expected.

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	3.3	0.0	2.9	1.8	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2s	0.0	0.0	0.0	0.0	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2h	0.0	0.0	0.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2k	0.0	0.0	0.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2r	0.0	0.0	0.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2v	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3h	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4a	36.7	50.0	40.0	18.2	15.5	11.8	6.2	0.0	3.3	0.0	0.0	0.0	2.9	10.0
4b	3.3	3.3	0.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4c	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4d	0.0	0.0	2.9	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4e	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4s	33.3	26.7	20.0	29.1	22.4	14.7	10.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4h	0.0	0.0	0.0	0.0	1.7	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4j	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4k	10.0	3.3	8.6	21.8	51.7	58.8	75.4	100.0	96.7	100.0	100.0	100.0	97.1	90.0
4m	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4p	0.0	3.3	8.6	1.8	1.7	2.9	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4r	3.3	10.0	2.9	1.8	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4v	3.3	3.3	5.7	10.9	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4x	3.3	0.0	2.9	5.5	1.7	2.9	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4y	3.3	0.0	0.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix 8:Ca. Continued.

Column 4 Oblique response expected.

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2s	0.0	0.0	0.0	4.0	7.1	0.0	0.0	0.0	0.0	3.1	0.0	0.0	0.0	0.0
2x	0.0	0.0	0.0	0.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3a	0.0	0.0	0.0	4.0	3.6	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3f	0.0	0.0	20.0	8.0	3.6	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3h	0.0	0.0	80.0	56.0	42.9	57.9	77.1	100.0	96.7	93.8	100.0	97.4	100.0	100.0
3j	0.0	0.0	0.0	0.0	10.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3k	0.0	0.0	0.0	12.0	17.9	23.7	17.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4a	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4k	0.0	0.0	0.0	16.0	10.7	7.9	2.9	0.0	3.3	3.1	0.0	2.6	0.0	0.0
4x	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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Column 5 Oblique or perspective response expected.

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2a	57.1	0.0	23.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0
2g	14.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2k	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2r	14.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2x	0.0	0.0	0.0	0.0	5.6	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3a	0.0	16.7	23.1	3.0	2.8	2.2	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0
3e	0.0	0.0	0.0	6.1	0.0	4.4	2.3	32.1	16.7	9.4	11.8	10.5	11.4	0.0
3f	0.0	0.0	0.0	0.0	8.3	2.2	6.8	3.6	0.0	3.1	0.0	0.0	0.0	0.0
3g	0.0	0.0	7.7	3.0	5.6	4.4	2.3	0.0	0.0	3.1	0.0	0.0	0.0	0.0
3h	0.0	0.0	0.0	6.1	16.7	20.0	36.4	57.1	66.7	68.8	76.5	76.3	82.9	90.0
3j	0.0	0.0	0.0	0.0	2.8	2.2	4.5	0.0	3.3	15.6	8.8	7.9	0.0	0.0
3k	0.0	0.0	0.0	12.1	13.9	13.3	4.5	3.6	3.3	0.0	0.0	0.0	0.0	0.0
3p	0.0	0.0	7.7	9.1	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3x	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4a	14.3	50.0	30.8	27.3	13.9	11.1	9.1	0.0	3.3	0.0	0.0	0.0	0.0	0.0
4g	0.0	16.7	7.7	6.1	11.1	2.2	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4k	0.0	0.0	0.0	24.2	19.4	28.9	27.3	3.6	6.7	0.0	2.9	2.6	2.9	10.0
4r	0.0	16.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4v	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4x	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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Column 6 Own drawing of a table.

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1a	33.3	40.0	31.4	14.5	1.7	7.4	4.6	0.0	0.0	0.0	0.0	2.6	0.0	0.0
1b	0.0	3.3	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1s	3.3	6.7	17.1	9.1	8.6	4.4	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1k	0.0	0.0	0.0	0.0	0.0	1.5	3.1	0.0	3.3	0.0	2.9	0.0	0.0	0.0
2a	20.0	13.3	17.1	7.3	8.6	2.9	4.6	3.6	0.0	0.0	0.0	0.0	0.0	0.0
2b	3.3	6.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2e	0.0	0.0	0.0	0.0	0.0	2.9	1.5	3.6	0.0	0.0	0.0	2.6	0.0	0.0
2f	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2s	26.7	23.3	11.4	29.1	22.4	16.2	6.2	3.6	3.3	3.1	0.0	2.6	0.0	0.0
2h	0.0	0.0	0.0	5.5	5.2	13.2	4.6	3.6	6.7	6.3	0.0	0.0	2.9	10.0
2j	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	3.3	6.3	0.0	0.0	0.0	0.0
2k	0.0	3.3	0.0	16.4	17.2	8.8	12.3	0.0	0.0	3.1	0.0	5.3	0.0	0.0
2n	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2p	0.0	0.0	2.9	1.8	3.4	4.4	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2q	0.0	0.0	0.0	1.8	0.0	0.0	6.2	3.6	3.3	0.0	0.0	0.0	0.0	0.0
2r	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0
2v	6.7	0.0	2.9	12.7	1.7	1.5	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2x	3.3	0.0	0.0	0.0	1.7	2.9	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3e	0.0	0.0	2.9	0.0	5.2	0.0	3.1	3.6	6.7	12.5	17.6	0.0	11.4	15.0
3f	0.0	0.0	0.0	0.0	1.7	2.9	1.5	0.0	0.0	3.1	0.0	0.0	0.0	0.0
3h	0.0	0.0	0.0	0.0	5.2	14.7	7.7	46.4	50.0	34.4	55.9	52.6	68.6	55.0
3j	0.0	0.0	2.9	0.0	1.7	7.4	16.9	3.6	10.0	25.0	14.7	23.7	11.4	0.0
3k	0.0	0.0	0.0	0.0	6.9	2.9	0.0	0.0	0.0	0.0	2.9	0.0	0.0	5.0
3p	0.0	0.0	2.9	0.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3r	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	0.0	0.0	2.9	0.0
4a	0.0	0.0	0.0	0.0	0.0	1.5	3.1	3.6	0.0	0.0	0.0	2.6	0.0	0.0
4s	0.0	0.0	2.9	0.0	0.0	1.5	0.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0
4k	0.0	0.0	0.0	1.8	5.2	2.9	9.2	21.4	13.3	3.1	5.9	7.9	2.9	10.0

Appendix 8:Ca. Continued.

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Column 7 = Oblique response expected.

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2a	0.0	0.0	20.0	8.0	7.1	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2g	0.0	0.0	0.0	12.0	7.1	2.6	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0
2k	0.0	0.0	0.0	16.0	10.7	7.9	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2p	0.0	0.0	20.0	0.0	0.0	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2r	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2v	0.0	0.0	0.0	8.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2x	0.0	0.0	0.0	4.0	7.1	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3a	0.0	0.0	0.0	4.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3e	0.0	0.0	0.0	4.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	14.3	0.0
3f	0.0	0.0	0.0	4.0	7.1	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3g	0.0	0.0	40.0	0.0	10.7	7.9	0.0	0.0	0.0	0.0	2.9	2.6	0.0	0.0
3h	0.0	0.0	0.0	8.0	10.7	26.3	74.3	92.9	100.0	100.0	97.1	97.4	77.1	100.0
3j	0.0	0.0	0.0	0.0	10.7	7.9	2.9	0.0	0.0	0.0	0.0	0.0	5.7	0.0
3k	0.0	0.0	0.0	8.0	25.0	18.4	8.6	3.6	0.0	0.0	0.0	0.0	0.0	0.0
3p	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3q	0.0	0.0	0.0	0.0	0.0	2.6	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3r	0.0	0.0	0.0	4.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0
3x	0.0	0.0	0.0	8.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3y	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4a	0.0	0.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4h	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4r	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix 8:Ca. Continued.

Column 8  Oblique or perspective response expected.

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	11.1	12.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1g	0.0	12.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2a	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2c	11.1	12.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2g	0.0	0.0	0.0	0.0	2.8	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2k	0.0	0.0	0.0	5.9	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2x	0.0	0.0	0.0	0.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3a	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3c	0.0	0.0	8.3	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3e	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0
3f	0.0	0.0	16.7	0.0	2.8	2.2	2.3	0.0	0.0	3.1	0.0	0.0	0.0	0.0
3g	0.0	0.0	0.0	8.8	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3h	0.0	0.0	0.0	5.9	5.6	23.9	34.9	50.0	60.0	62.5	44.1	71.1	71.4	95.0
3j	0.0	0.0	0.0	2.9	2.8	4.3	2.3	3.6	6.7	12.5	5.9	0.0	11.4	0.0
3k	0.0	0.0	0.0	5.9	22.2	15.2	7.0	7.1	6.7	0.0	2.9	0.0	0.0	0.0
3p	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4a	0.0	0.0	8.3	5.9	5.6	4.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4b	0.0	12.5	0.0	0.0	0.0	0.0	0.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0
4c	55.6	37.5	0.0	5.9	2.8	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4d	11.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4e	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0
4g	11.1	0.0	25.0	14.7	16.7	2.2	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4h	0.0	0.0	8.3	0.0	0.0	2.2	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4k	0.0	0.0	25.0	38.2	33.3	32.6	44.2	35.7	26.7	21.9	41.2	28.9	17.1	5.0
4p	0.0	12.5	8.3	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4x	0.0	0.0	0.0	0.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4y	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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Column 9 ⊏ Vertical oblique response expected.

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20!
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2a	0.0	0.0	60.0	12.0	7.1	10.5	11.4	14.3	16.7	12.5	26.5	31.6	22.9	30.0
2e	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.1	0.0	9.4	5.9	7.9	0.0	0.0
2s	0.0	0.0	20.0	16.0	32.1	21.1	14.3	3.6	3.3	0.0	2.9	0.0	0.0	0.0
2h	0.0	0.0	20.0	4.0	3.6	5.3	0.0	14.3	20.0	12.5	8.8	2.6	2.9	5.0
2j	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	0.0	6.3	2.9	0.0	0.0	0.0
2k	0.0	0.0	0.0	24.0	32.1	42.1	51.4	10.7	20.0	25.0	23.5	18.4	5.7	0.0
2p	0.0	0.0	0.0	4.0	0.0	2.6	11.4	0.0	0.0	0.0	0.0	0.0	8.6	0.0
2q	0.0	0.0	0.0	4.0	3.6	2.6	2.9	14.3	10.0	21.9	11.8	7.9	25.7	10.0
2r	0.0	0.0	0.0	8.0	0.0	7.9	2.9	32.1	20.0	3.1	2.9	21.1	22.9	50.0
2v	0.0	0.0	0.0	20.0	7.1	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0
2x	0.0	0.0	0.0	8.0	10.7	5.3	0.0	0.0	10.0	3.1	2.9	0.0	2.9	0.0
2z	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0
3e	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0
3h	0.0	0.0	0.0	0.0	0.0	2.6	5.7	0.0	0.0	3.1	5.9	10.5	5.7	5.0
3k	0.0	0.0	0.0	0.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4k	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	0.0	0.0	0.0	0.0

Column 10 Oblique response expected.

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	28.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3a	0.0	0.0	7.1	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3e	0.0	0.0	0.0	3.2	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3f	0.0	20.0	0.0	3.2	8.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3h	71.4	60.0	92.9	54.8	58.8	67.4	88.4	92.9	93.3	100.0	100.0	100.0	100.0	100.0
3J	0.0	20.0	0.0	9.7	14.7	4.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3k	0.0	0.0	0.0	29.0	14.7	23.9	11.6	7.1	6.7	0.0	0.0	0.0	0.0	0.0
4h	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix 8:Ca. Continued.

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Column 11 Perspective response expected.

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	28.6	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2s	0.0	0.0	0.0	3.2	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2k	28.6	20.0	14.3	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2x	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3a	0.0	0.0	7.1	3.2	0.0	4.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3s	0.0	0.0	0.0	3.2	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	13.3	34.4	20.6	21.1	11.4	25.0
3k	14.3	0.0	7.1	19.4	14.7	28.3	23.3	50.0	40.0	21.9	0.0	5.3	22.9	5.0
3p	0.0	0.0	0.0	3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4a	0.0	0.0	0.0	3.2	2.9	4.3	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4s	0.0	20.0	0.0	6.5	23.5	2.2	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4h	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4k	28.6	40.0	71.4	58.1	44.1	56.5	72.1	46.4	46.7	43.8	79.4	73.7	65.7	70.0
4p	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4x	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix 8:Ca. Continued.

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Column 12 — Variable response expected.

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1s	0.0	0.0	0.0	4.0	0.0	0.0	0.0	10.7	3.3	3.1	5.9	0.0	5.7	15.0
1k	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0
1r	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	0.0	0.0	0.0	0.0
2a	0.0	0.0	10.0	4.0	14.3	15.8	5.7	0.0	0.0	0.0	0.0	2.6	0.0	0.0
2g	0.0	0.0	20.0	28.0	21.4	13.2	5.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2h	0.0	0.0	0.0	0.0	3.6	5.3	0.0	10.7	0.0	0.0	0.0	2.6	0.0	0.0
2j	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	0.0	6.3	0.0	0.0	0.0	0.0
2k	0.0	0.0	20.0	20.0	17.9	26.3	17.1	3.6	3.3	6.3	0.0	2.6	2.9	5.0
2p	0.0	0.0	20.0	4.0	7.1	5.3	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0
2q	0.0	0.0	0.0	0.0	3.6	0.0	2.9	0.0	3.3	0.0	0.0	0.0	2.9	0.0
2r	0.0	0.0	0.0	8.0	0.0	2.6	0.0	7.1	0.0	0.0	0.0	2.6	0.0	0.0
2v	0.0	0.0	0.0	8.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2x	0.0	0.0	0.0	8.0	10.7	5.3	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2y	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0
3e	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7	13.3	15.6	11.8	0.0	14.3	10.0
3f	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.3	0.0	0.0	0.0	0.0
3g	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9	0.0	2.9	0.0
3h	0.0	0.0	0.0	0.0	0.0	5.3	20.0	32.1	40.0	46.9	50.0	71.1	51.4	40.0
3j	0.0	0.0	0.0	0.0	0.0	5.3	14.3	7.1	13.3	9.4	5.9	7.9	2.9	15.0
3k	0.0	0.0	0.0	4.0	7.1	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3p	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4a	0.0	0.0	0.0	0.0	3.6	0.0	5.7	3.6	6.7	0.0	0.0	0.0	0.0	0.0
4g	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	5.0
4h	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4j	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0
4k	0.0	0.0	0.0	8.0	7.1	7.9	20.0	7.1	13.3	3.1	17.6	7.9	14.3	10.0
4p	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0

Appendix 8:Ca. Continued.

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Column 13 Perspective response expected.

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	14.3	16.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2s	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2x	0.0	0.0	0.0	0.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4a	0.0	0.0	0.0	3.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0
4b	0.0	16.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4s	0.0	0.0	15.4	9.1	22.2	2.2	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4h	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0
4k	85.7	66.7	84.6	87.9	75.0	71.1	95.5	100.0	100.0	96.9	100.0	100.0	97.1	95.0
4r	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	0.0	0.0	0.0	0.0

Appendix 8:Ca. Continued.

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Column 14 ☐ Vertical oblique response expected.

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2a	0.0	0.0	40.0	16.0	14.3	10.5	5.7	17.9	13.3	15.6	26.5	31.6	22.9	25.0
2e	0.0	0.0	0.0	0.0	0.0	2.6	0.0	7.1	0.0	6.3	0.0	5.3	0.0	0.0
2f	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2g	0.0	0.0	20.0	20.0	28.6	10.5	14.3	7.1	3.3	0.0	0.0	2.6	0.0	0.0
2h	0.0	0.0	20.0	0.0	0.0	7.9	8.6	14.3	30.0	9.4	11.8	7.9	0.0	0.0
2J	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	3.1	8.8	0.0	0.0	0.0
2k	0.0	0.0	20.0	32.0	28.6	47.4	45.7	17.9	16.7	37.5	23.5	18.4	11.4	0.0
2p	0.0	0.0	0.0	4.0	7.1	7.9	2.9	0.0	0.0	0.0	0.0	0.0	8.6	5.0
2q	0.0	0.0	0.0	0.0	3.6	7.9	11.4	10.7	10.0	25.0	14.7	13.2	25.7	10.0
2r	0.0	0.0	0.0	0.0	3.6	2.6	2.9	25.0	13.3	0.0	2.9	15.8	25.7	60.0
2v	0.0	0.0	0.0	16.0	7.1	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0
2x	0.0	0.0	0.0	8.0	7.1	2.6	2.9	0.0	13.3	3.1	5.9	0.0	2.9	0.0
2z	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0
3e	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0
3h	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	2.6	0.0	0.0
4k	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0

Appendix 8:Ca. Continued.

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Column 15 — Perspective response expected.

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1a	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.1
2a	0.0	0.0	0.0	8.3	14.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2s	0.0	0.0	0.0	16.7	14.3	5.0	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2h	0.0	0.0	50.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2k	0.0	0.0	0.0	25.0	0.0	5.0	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2q	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9	0.0	0.0	0.0	0.0
2v	0.0	0.0	0.0	8.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2x	0.0	0.0	0.0	0.0	7.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3	0.0	0.0
3q	0.0	0.0	0.0	0.0	7.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4a	0.0	0.0	50.0	0.0	7.1	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4s	0.0	0.0	0.0	8.3	14.3	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4k	0.0	0.0	0.0	33.3	35.7	55.0	88.9	100.0	100.0	94.1	100.0	94.7	100.0	88.9
4p	0.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix 8:Ca. Continued.

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Column 16 ← oblique response expected.

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2g	0.0	0.0	0.0	8.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2k	0.0	0.0	0.0	4.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2x	0.0	0.0	0.0	0.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3a	0.0	0.0	20.0	12.0	10.7	7.9	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3e	0.0	0.0	20.0	4.0	0.0	2.6	2.9	0.0	0.0	0.0	0.0	0.0	5.7	15.0
3f	0.0	0.0	20.0	12.0	7.1	0.0	5.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3g	0.0	0.0	40.0	8.0	10.7	13.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3h	0.0	0.0	0.0	8.0	10.7	28.9	60.0	100.0	96.7	100.0	97.1	100.0	85.7	85.0
3j	0.0	0.0	0.0	0.0	10.7	10.5	14.3	0.0	0.0	0.0	2.9	0.0	8.6	0.0
3k	0.0	0.0	0.0	12.0	25.0	13.2	11.4	0.0	3.3	0.0	0.0	0.0	0.0	0.0
3p	0.0	0.0	0.0	0.0	0.0	7.9	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3q	0.0	0.0	0.0	0.0	3.6	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3r	0.0	0.0	0.0	4.0	0.0	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3x	0.0	0.0	0.0	12.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4g	0.0	0.0	0.0	0.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4k	0.0	0.0	0.0	12.0	7.1	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4v	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4x	0.0	0.0	0.0	0.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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Column 17 ⊓ *Variable response expected.*

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	14.3	27.3	0.0	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1a	28.6	0.0	9.1	6.3	2.8	4.4	5.0	0.0	0.0	3.1	0.0	2.6	8.6	25.0
1s	28.6	0.0	0.0	6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1k	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	3.1	0.0	0.0	0.0	0.0
1v	14.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2a	0.0	18.2	36.4	9.4	13.9	8.9	7.5	7.1	3.3	0.0	2.9	5.3	0.0	0.0
2e	0.0	0.0	0.0	3.1	0.0	0.0	0.0	3.6	0.0	6.3	0.0	0.0	0.0	0.0
2s	0.0	0.0	9.1	18.8	27.8	15.6	2.5	0.0	3.3	0.0	2.9	0.0	0.0	0.0
2h	0.0	0.0	0.0	0.0	5.6	6.7	2.5	10.7	10.0	3.1	2.9	0.0	0.0	0.0
2j	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	0.0	3.1	0.0	0.0	0.0	0.0
2k	0.0	9.1	9.1	15.6	19.4	26.7	20.0	14.3	6.7	12.5	5.9	7.9	0.0	0.0
2p	14.3	0.0	0.0	9.4	0.0	13.3	15.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0
2q	0.0	0.0	0.0	0.0	2.8	0.0	5.0	7.1	3.3	3.1	2.9	2.6	0.0	0.0
2r	0.0	18.2	18.2	3.1	2.8	2.2	2.5	14.3	6.7	3.1	2.9	2.6	0.0	10.0
2v	0.0	0.0	9.1	6.3	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2x	0.0	0.0	0.0	6.3	5.6	4.4	2.5	0.0	3.3	3.1	0.0	2.6	0.0	0.0
2y	0.0	0.0	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3e	0.0	0.0	0.0	3.1	2.8	0.0	0.0	10.7	10.0	12.5	17.6	5.3	2.9	0.0
3f	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	0.0	0.0	0.0	0.0
3h	0.0	0.0	0.0	3.1	2.8	13.3	12.5	10.7	40.0	28.1	35.3	60.5	54.3	50.0
3j	0.0	0.0	0.0	0.0	0.0	0.0	7.5	7.1	3.3	9.4	2.9	5.3	5.7	5.0
3k	0.0	0.0	0.0	0.0	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3r	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0
4a	0.0	18.2	0.0	3.1	2.8	0.0	2.5	3.6	3.3	0.0	0.0	0.0	0.0	0.0
4s	0.0	9.1	0.0	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4k	0.0	0.0	0.0	0.0	2.8	4.4	15.0	7.1	3.3	6.3	20.6	5.3	22.9	10.0
4r	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0

Appendix 8:Ca. Continued.

Column 18  *Oblique response expected.*

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	10.8	7.1	0.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2a	0.0	0.0	0.0	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2c	6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2e	0.0	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2g	6.3	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2h	12.5	21.4	15.0	7.1	2.3	3.8	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2k	0.0	0.0	0.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3b	0.0	14.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3f	0.0	7.1	0.0	4.8	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3g	0.0	14.3	0.0	0.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3h	43.8	35.7	60.0	66.7	72.7	73.6	86.5	89.3	96.7	100.0	100.0	100.0	97.1	100.0
3J	12.5	0.0	20.0	2.4	6.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3k	0.0	0.0	0.0	16.7	4.5	18.9	9.6	10.7	3.3	0.0	0.0	0.0	2.9	0.0

Appendix 8:Ca. Continued.

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Column 19  Oblique response expected.

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	85.7	27.3	18.2	3.1	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2g	0.0	0.0	0.0	0.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3a	0.0	0.0	0.0	3.1	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3e	0.0	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3f	0.0	9.1	18.2	6.3	8.3	6.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3g	0.0	27.3	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3h	14.3	18.2	45.5	36.3	58.3	62.2	87.5	92.9	96.7	100.0	100.0	100.0	100.0	100.0
3j	0.0	9.1	9.1	9.4	16.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3k	0.0	0.0	0.0	21.9	13.9	26.7	12.5	7.1	3.3	0.0	0.0	0.0	0.0	0.0

Appendix 8:Ca. Continued.

Column 20 L Vertical oblique response expected.

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1a	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	2.6	0.0	15.0
2a	0.0	0.0	40.0	20.0	10.7	15.8	5.7	17.9	13.3	12.5	23.5	34.2	28.6	25.0
2e	0.0	0.0	20.0	0.0	0.0	2.6	0.0	3.6	0.0	6.3	0.0	5.3	0.0	0.0
2g	0.0	0.0	40.0	16.0	28.6	10.5	2.9	3.6	6.7	3.1	0.0	0.0	0.0	0.0
2h	0.0	0.0	0.0	8.0	3.6	5.3	11.4	10.7	20.0	6.3	8.8	5.3	0.0	0.0
2j	0.0	0.0	0.0	0.0	0.0	0.0	2.9	3.6	3.3	6.3	2.9	0.0	0.0	0.0
2k	0.0	0.0	0.0	32.0	25.0	36.8	48.6	14.3	13.3	34.4	20.6	18.4	5.7	5.0
2f	0.0	0.0	0.0	8.0	3.6	7.9	11.4	0.0	0.0	0.0	0.0	0.0	8.6	0.0
2q	0.0	0.0	0.0	0.0	3.6	5.3	11.4	14.3	10.0	25.0	20.6	5.3	22.9	0.0
2r	0.0	0.0	0.0	4.0	0.0	7.9	2.9	28.6	16.7	0.0	0.0	18.4	25.7	55.0
2v	0.0	0.0	0.0	4.0	7.1	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0
2x	0.0	0.0	0.0	8.0	10.7	2.6	2.9	0.0	16.7	3.1	2.9	0.0	2.9	0.0
3e	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9	0.0	0.0	0.0
3h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	0.0	3.1	5.9	10.5	5.7	0.0
3r	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4h	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4k	0.0	0.0	0.0	0.0	7.1	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0

Appendix 8:Ca. Continued.

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Column 21 → Perspective response expected.

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20!
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2a	0.0	0.0	0.0	0.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2s	0.0	0.0	0.0	8.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2h	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2k	0.0	0.0	0.0	4.0	0.0	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2q	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	0.0	0.0	0.0	0.0
2x	0.0	0.0	20.0	0.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3a	0.0	0.0	20.0	4.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3e	0.0	0.0	0.0	0.0	0.0	5.3	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.0
3s	0.0	0.0	0.0	4.0	3.6	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3h	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0	3.3	0.0	0.0	0.0	2.9	5.0
3J	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0
3k	0.0	0.0	0.0	0.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3x	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4a	0.0	0.0	20.0	12.0	10.7	5.3	5.7	0.0	0.0	0.0	0.0	0.0	2.9	5.0
4s	0.0	0.0	40.0	12.0	21.4	7.9	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4h	0.0	0.0	0.0	4.0	0.0	2.6	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4k	0.0	0.0	0.0	32.0	42.9	52.6	85.7	100.0	96.7	93.8	100.0	97.4	91.4	85.0
4p	0.0	0.0	0.0	8.0	0.0	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4q	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	0.0	0.0	0.0	0.0
4r	0.0	0.0	0.0	4.0	0.0	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0
4v	0.0	0.0	0.0	4.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4x	0.0	0.0	0.0	0.0	3.6	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix 8:Ca. Continued.

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Column 22 ▱ Oblique response expected.

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	3.3	0.0	2.9	3.6	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3a	10.0	23.3	11.4	9.1	3.4	1.5	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3b	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3c	0.0	6.7	5.7	0.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3e	6.7	6.7	14.3	3.6	12.1	4.4	6.2	0.0	0.0	0.0	0.0	0.0	5.7	5.0
3f	3.3	3.3	11.4	5.5	15.5	5.9	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3g	26.7	26.7	5.7	18.2	10.3	4.4	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3h	3.3	3.3	2.9	12.7	13.8	32.4	60.0	76.4	100.0	100.0	100.0	100.0	88.6	90.0
3J	0.0	3.3	8.6	10.9	12.1	14.7	16.9	0.0	0.0	0.0	0.0	0.0	5.7	0.0
3k	3.3	3.3	0.0	12.7	13.8	19.1	3.1	3.6	0.0	0.0	0.0	0.0	0.0	0.0
3n	0.0	0.0	2.9	3.6	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3p	16.7	3.3	25.7	14.5	3.4	8.8	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3q	0.0	0.0	0.0	0.0	1.7	1.5	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3r	3.3	3.3	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0
3v	20.0	6.7	5.7	3.6	3.4	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3x	0.0	3.3	2.9	1.8	1.7	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3y	3.3	3.3	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3z	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix 8:Ca. Continued.

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Column 23 ∠ Obligue or perspective response expected.

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2s	0.0	0.0	0.0	4.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2x	0.0	0.0	0.0	0.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3a	0.0	0.0	20.0	4.0	3.6	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3e	0.0	0.0	0.0	0.0	0.0	2.6	0.0	10.7	10.0	15.6	14.7	2.6	8.6	10.0
3f	0.0	0.0	20.0	4.0	0.0	0.0	2.9	0.0	10.0	6.3	0.0	0.0	0.0	0.0
3s	0.0	0.0	0.0	4.0	7.1	2.6	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0
3h	0.0	0.0	0.0	0.0	7.1	15.8	28.6	28.6	46.7	50.0	50.0	57.9	60.0	80.0
3j	0.0	0.0	0.0	8.0	0.0	5.3	17.1	7.1	6.7	15.6	2.9	7.9	8.6	0.0
3k	0.0	0.0	0.0	8.0	10.7	10.5	8.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3p	0.0	0.0	0.0	0.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3q	0.0	0.0	0.0	0.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3r	0.0	0.0	0.0	8.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3v	0.0	0.0	0.0	0.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3x	0.0	0.0	0.0	4.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4a	0.0	0.0	20.0	4.0	7.1	7.9	5.7	3.6	0.0	0.0	0.0	0.0	0.0	0.0
4s	0.0	0.0	40.0	12.0	17.9	5.3	8.6	3.6	0.0	0.0	0.0	2.6	0.0	0.0
4h	0.0	0.0	0.0	0.0	0.0	5.3	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4j	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0
4k	0.0	0.0	0.0	32.0	28.6	37.5	22.9	42.9	26.7	12.5	27.4	28.9	22.9	10.0
4p	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4v	0.0	0.0	0.0	8.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix 8:Ca. Continued.

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Column 24 Perspective response expected.

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	57.1	20.0	14.3	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1k	14.3	40.0	7.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2s	0.0	0.0	0.0	6.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2v	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2x	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4a	0.0	0.0	7.1	3.2	8.8	4.3	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4s	0.0	40.0	0.0	9.7	26.5	2.2	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4h	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4k	28.6	0.0	64.3	77.4	58.8	89.1	95.3	100.0	100.0	100.0	100.0	100.0	100.0	100.0
4v	0.0	0.0	0.0	3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4x	0.0	0.0	7.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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Column 25 Choice

	4,0	5,0	6,0	7,0	8,0	9,0	10,0	11,0	12,0	13,0	14,0	15,0	16,2020+	
0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
1a	0,0	0,0	2,9	1,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2a	6,7	3,3	2,9	0,0	0,0	0,0	0,0	3,6	0,0	0,0	0,0	0,0	0,0	0,0
2b	0,0	3,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2e	0,0	0,0	0,0	0,0	0,0	0,0	0,0	3,6	0,0	0,0	0,0	0,0	0,0	0,0
2g	3,9	0,0	2,9	1,8	0,0	1,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2h	0,0	0,0	0,0	0,0	0,0	0,0	1,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2k	0,0	3,3	2,9	0,0	0,0	0,0	4,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2p	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	5,0
2q	0,0	0,0	0,0	0,0	0,0	0,0	1,5	0,0	0,0	0,0	2,9	0,0	0,0	0,0
2r	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	5,0
2x	3,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
3a	6,7	6,7	2,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
3c	0,0	3,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
3e	0,0	3,3	2,9	1,8	6,7	0,0	1,5	3,6	6,7	3,1	0,0	0,0	2,9	10,0
3f	3,3	3,3	5,7	1,8	5,0	3,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
3g	10,0	16,7	0,0	3,6	0,0	0,0	0,0	0,0	0,0	0,0	2,9	0,0	0,0	0,0
3h	43,3	30,0	57,1	65,5	75,0	68,2	80,0	67,9	73,3	84,4	76,5	78,9	77,1	65,0
3j	6,7	10,0	17,1	7,3	6,7	3,0	3,1	0,0	6,7	3,1	0,0	7,9	0,0	0,0
3k	3,3	0,0	0,0	14,5	3,3	15,2	1,5	0,0	0,0	3,1	0,0	0,0	0,0	0,0
3p	3,3	0,0	0,0	0,0	0,0	0,0	1,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0
3v	6,7	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
3x	0,0	3,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
4a	3,3	6,7	0,0	0,0	0,0	1,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
4g	0,0	3,3	0,0	0,0	1,7	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
4k	0,0	3,3	2,9	7,3	1,7	6,1	3,1	21,4	13,3	6,3	17,6	13,2	20,0	15,0
4p	0,0	0,0	0,0	0,0	0,0	1,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0

Appendix 8:Cb. Analysis of amalgamated data, classified by projection system, stimulus and age.

Table D. % Responses for numbers 1-4 against age for columns 1-25

Column 1 

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	6.3	15.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	31.3	26.3	27.8	12.2	11.4	11.3	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	16.7	9.8	9.1	13.2	12.5	0.0	6.7	9.4	2.9	5.3	14.3	15.0
4	62.5	57.9	55.6	78.0	79.5	73.6	85.4	100.0	93.3	90.6	97.1	94.7	85.7	85.0

Column 2 =

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	100.0	96.0	96.4	92.1	91.4	96.4	100.0	96.9	82.4	89.5	91.4	85.0
3	0.0	0.0	0.0	4.0	0.0	2.6	5.7	3.6	0.0	3.1	5.9	10.5	5.7	10.0
4	0.0	0.0	0.0	0.0	3.6	5.3	2.9	0.0	0.0	0.0	11.8	0.0	2.9	5.0

Appendix 8:Cb. Continued.

Column 3

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	3.3	0.0	2.9	1.8	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	2.9	5.5	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	96.7	100.0	94.3	92.7	96.6	98.5	98.5	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Column 4

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	4.0	10.7	0.0	0.0	0.0	0.0	3.1	0.0	0.0	0.0	0.0
3	0.0	0.0	100.0	80.0	78.6	87.5	94.3	100.0	96.7	93.8	100.0	97.4	100.0	100.0
4	0.0	0.0	0.0	16.0	10.7	10.5	5.7	0.0	3.3	3.1	0.0	2.6	0.0	0.0

Appendix 8:Cb. Continued.

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Column 5 G1

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	85.7	0.0	23.1	0.0	5.6	4.4	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0
3	0.0	16.7	38.5	39.4	50.0	51.1	57.1	96.4	90.0	100.0	97.1	94.7	97.1	90.0
4	14.3	83.3	38.5	60.6	44.4	42.2	40.9	3.6	10.0	0.0	2.9	2.6	2.9	10.0

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Column 6 Own

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	36.7	50.0	48.6	23.6	12.1	13.2	9.2	0.0	3.3	0.0	2.9	2.6	0.0	0.0
2	60.0	50.0	40.0	74.5	60.3	52.9	47.7	17.9	16.7	18.8	0.0	10.5	2.9	15.0
3	0.0	0.0	8.6	0.0	22.4	27.9	30.8	53.6	66.7	78.1	91.2	76.3	94.3	75.0
4	0.0	0.0	2.9	1.8	5.2	5.9	12.3	28.6	13.3	3.1	5.9	10.5	2.9	10.0

Appendix 8:Cb. Continued.

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Column 7

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	40.0	52.0	35.7	23.7	5.7	3.6	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	40.0	48.0	64.3	71.1	94.3	96.4	100.0	100.0	100.0	100.0	100.0	100.0
4	0.0	0.0	20.0	0.0	0.0	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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Column 8

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	11.1	12.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	12.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	11.1	12.5	0.0	5.9	5.6	6.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	25.0	26.5	33.3	47.8	51.2	60.7	73.3	78.1	55.9	71.1	82.9	95.0
4	77.8	62.5	75.0	67.6	61.1	45.7	48.8	39.3	26.7	21.9	44.1	28.9	17.1	5.0

Appendix 8:Cb. Continued.

Column 9 

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	100.0	100.0	96.4	97.4	94.3	100.0	100.0	93.8	91.2	89.5	94.3	95.0
3	0.0	0.0	0.0	0.0	3.6	2.6	5.7	0.0	0.0	3.1	8.8	10.5	5.7	5.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	0.0	0.0	0.0	0.0

Column 10 

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	28.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	71.4	100.0	100.0	100.0	100.0	97.8	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
4	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix 8:Cb. Continued.

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Column 11

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	28.6	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	28.6	20.0	14.3	3.2	8.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	14.3	0.0	14.3	29.0	17.6	32.6	23.3	53.6	53.3	56.3	20.6	26.3	34.3	30.0
4	28.6	60.0	71.4	67.7	73.5	67.4	76.7	46.4	46.7	43.8	79.4	73.7	65.7	70.0

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Column 12

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	4.0	0.0	0.0	0.0	10.7	3.3	6.3	8.8	0.0	5.7	15.0
2	0.0	0.0	100.0	84.0	82.1	73.7	34.3	25.0	10.0	12.5	0.0	10.5	8.6	5.0
3	0.0	0.0	0.0	4.0	7.1	13.2	37.1	50.0	66.7	78.1	73.5	78.9	71.4	65.0
4	0.0	0.0	0.0	8.0	10.7	13.2	28.6	14.3	20.0	3.1	17.6	10.5	14.3	15.0

Appendix 8:Cb. Continued.

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Column 13 

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	14.3	16.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	2.8	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	85.7	83.3	100.0	100.0	97.2	97.8	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

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Column 14 

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	100.0	100.0	100.0	100.0	97.1	100.0	100.0	100.0	97.1	94.7	100.0	100.0
3	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0	2.9	2.6	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0

Appendix 8:Cb. Continued.

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Column 15

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.1
2	0.0	0.0	50.0	58.3	35.7	15.0	11.1	0.0	0.0	5.9	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	7.1	0.0	0.0	0.0	0.0	0.0	0.0	5.3	0.0	0.0
4	0.0	0.0	50.0	41.7	57.1	85.0	88.9	100.0	100.0	94.1	100.0	94.7	100.0	88.9

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Column 16

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	12.0	7.1	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	100.0	72.0	78.6	92.1	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
4	0.0	0.0	0.0	16.0	14.3	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix 8:Cb. Continued.

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Column 17 

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	14.3	27.3	0.0	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	71.4	0.0	9.1	12.5	2.8	4.4	5.0	0.0	3.3	6.3	0.0	2.6	8.6	25.0
2	14.3	45.5	90.9	71.9	80.6	77.8	57.5	60.7	36.7	34.4	20.6	21.1	2.9	10.0
3	0.0	0.0	0.0	6.3	11.1	13.3	20.0	28.6	53.3	53.1	55.9	71.1	65.7	55.0
4	0.0	27.3	0.0	6.3	5.6	4.4	17.5	10.7	6.7	6.3	23.5	5.3	22.9	10.0

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Column 18 

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	18.8	7.1	0.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	25.0	21.4	20.0	9.5	4.5	5.7	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	56.3	71.4	80.0	90.5	95.5	92.5	98.1	100.0	100.0	100.0	100.0	100.0	100.0	100.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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Column 19 

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	85.7	27.3	18.2	3.1	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	14.3	72.7	81.8	96.9	97.2	97.8	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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Column 20 

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	2.6	0.0	15.0
2	0.0	0.0	100.0	100.0	92.9	94.7	100.0	96.4	100.0	96.9	82.4	86.8	94.3	85.0
3	0.0	0.0	0.0	0.0	0.0	2.6	0.0	3.6	0.0	3.1	11.8	10.5	5.7	0.0
4	0.0	0.0	0.0	0.0	7.1	2.6	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0

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Column 21 

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	20.0	12.0	10.7	7.9	0.0	0.0	0.0	3.1	0.0	0.0	0.0	0.0
3	0.0	0.0	20.0	12.0	7.1	10.5	2.9	0.0	3.3	0.0	0.0	2.6	5.7	5.0
4	0.0	0.0	60.0	76.0	82.1	81.6	97.1	100.0	96.7	96.9	100.0	97.4	94.3	95.0

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Column 22 

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	3.3	0.0	2.9	3.6	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	96.7	100.0	97.1	96.4	100.0	98.5	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix 8:Cb. Continued.

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Column 23

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	4.0	3.6	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	40.0	40.0	42.9	36.8	60.0	46.4	73.3	87.5	70.6	68.4	77.1	90.0
4	0.0	0.0	60.0	56.0	53.6	60.5	40.0	53.6	26.7	12.5	29.4	31.6	22.9	10.0

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Column 24

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	57.1	20.0	14.3	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	14.3	40.0	7.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	6.5	5.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	28.6	40.0	78.6	93.5	94.1	97.8	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Appendix 8:Cb. Continued.

Column 25 *Choice*

	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16-20	20+
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	2.9	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	13.3	10.0	9.0	1.8	0.0	1.5	7.6	7.1	0.0	0.0	2.9	0.0	0.0	10.0
3	83.4	76.6	85.2	89.1	96.6	89.4	89.3	71.4	86.7	93.8	79.4	86.8	80.0	75.0
4	3.3	13.3	2.9	7.3	3.4	19.1	3.1	21.4	13.3	6.3	17.6	13.2	20.0	15.0

Appendix 8:Cc. Analysis of amalgamated data, classified by depth cue, stimulus and age.

Analysis of table legs, given as proportions of the total for each age group.

Key:-
1 = stimulus unaltered.
2 = No ground line, no partial occlusion.
3 = Ground line, legs from back, no partial occlusion.
4 = Ground line, legs from front, no partial occlusion.
5 = Ground plane, no partial occlusion.
6 = Ground line, partial occlusion.
7 = Ground plane, partial occlusion (perspective).
8 = Ground plane, partial occlusion (oblique).

A = Stimulus unaltered. B = No ground line. C = Ground line. D = Ground plane. E = Partial occlusion.

Analysis of table legs, Column 1. 

Table Top	Leg Gp.	Age in Years. 4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
0	1	6,3	15,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
1	4	0,0	0,0	0,0	0,0	0,0	1,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2	4	0,0	5,3	0,0	7,3	0,0	1,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2	7	31,3	21,1	27,8	4,9	11,4	9,4	2,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0
3	2	0,0	0,0	0,0	2,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
3	4	0,0	0,0	0,0	0,0	2,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
3	6	0,0	0,0	0,0	2,4	2,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
3	7	0,0	0,0	16,7	4,9	4,5	13,2	12,5	0,0	3,3	3,1	0,0	0,0	11,4	5,0
3	8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	3,3	6,3	2,9	5,3	2,9	10,0
4	2	6,3	0,0	5,6	2,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
4	4	0,0	31,6	16,7	12,2	20,5	7,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
4	7	56,3	26,3	33,3	63,4	59,1	64,2	85,4	100,0	93,3	90,6	97,1	94,7	85,7	85,0
4	8	0,0	0,0	0,0	0,0	0,0	1,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0

Analysis of Categories of table legs, Column 1.

Leg Category	Age in Years. 4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
1	6,3	15,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2	6,3	0,0	5,6	4,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
4	0,0	36,8	16,7	19,5	22,7	11,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
6	0,0	0,0	0,0	2,4	2,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
7	87,5	47,4	77,8	73,2	75,0	86,8	100,0	100,0	96,7	93,8	97,1	94,7	97,1	90,0
8	0,0	0,0	0,0	0,0	0,0	1,9	0,0	0,0	3,3	6,3	2,9	5,3	2,9	10,0

Analysis of Use of Depth Cues, Column 1.

Depth Cue.	Age in Years. 4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
A	6,3	15,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
B	6,3	0,0	5,6	4,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
C	0,0	36,8	16,7	21,9	25,0	11,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
D	87,5	47,4	77,8	73,2	75,0	88,7	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0
E	87,5	47,4	77,8	75,6	77,3	86,8	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0

Appendix 8:Cc. Continued.

Analysis of table legs, Column 2.

Table Top	Leg No.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
0	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	2	0.0	0.0	20.0	44.0	32.1	13.1	11.5	26.0	16.7	6.3	2.9	10.5	31.4	45.0
2	4	0.0	0.0	80.0	28.0	28.6	23.7	22.9	17.9	13.3	15.6	29.4	44.7	28.6	30.0
2	5	0.0	0.0	0.0	0.0	7.1	0.0	5.7	17.9	20.0	21.9	20.5	10.5	22.9	10.0
2	7	0.0	0.0	0.0	20.0	25.0	52.6	51.4	21.4	26.7	40.6	26.5	23.7	8.6	0.0
2	8	0.0	0.0	0.0	4.0	3.6	2.6	0.0	14.2	23.3	12.5	3.5	0.0	0.0	0.0
3	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0
3	7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0
3	8	0.0	0.0	0.0	0.0	0.0	2.6	5.7	0.0	0.0	3.1	3.0	10.5	5.7	10.0
4	4	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	7	0.0	0.0	0.0	0.0	3.6	0.0	2.9	0.0	0.0	0.0	11.8	0.0	2.9	0.0
4	8	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0

Analysis of Categories of table legs, Column 2.

Leg Category	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	20.0	44.0	32.1	13.1	11.5	25.0	16.7	6.3	2.9	10.5	31.4	45.0
4	0.0	0.0	80.0	28.0	28.6	26.3	22.9	17.9	13.3	15.6	29.4	44.7	28.6	30.0
5	0.0	0.0	0.0	0.0	7.1	0.0	5.7	17.9	20.0	21.9	23.4	10.5	22.9	10.0
7	0.0	0.0	0.0	24.0	28.6	52.6	54.3	25.0	26.7	40.6	38.2	23.7	11.4	0.0
8	0.0	0.0	0.0	4.0	3.6	7.9	5.7	14.2	23.3	12.5	6.5	10.5	5.7	15.0

Analysis of Use of Depth Cues, Column 2.

Depth Cue	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B	0.0	0.0	20.0	44.0	32.1	13.1	11.5	25.0	16.7	6.3	2.9	10.5	31.4	45.0
C	0.0	0.0	80.0	28.0	28.6	26.3	22.9	17.9	13.3	15.6	29.4	44.7	28.6	30.0
D	0.0	0.0	0.0	28.0	39.3	60.5	65.7	57.1	70.0	78.1	67.6	44.7	40.0	25.0
E	0.0	0.0	0.0	28.0	32.3	60.5	60.0	39.2	50.0	53.1	44.7	34.2	17.1	15.0

Appendix 8:Cc. Continued.

Analysis of table legs, Column 3. 

Table	Leg	Age in Years,													
Top	Gp.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
0	1	3,3	0,0	2,9	1,8	0,0	1,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2	2	0,0	0,0	2,9	1,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2	4	0,0	0,0	0,0	0,0	3,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2	7	0,0	0,0	0,0	1,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2	8	0,0	0,0	0,0	1,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
3	8	0,0	0,0	0,0	0,0	0,0	0,0	1,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0
4	2	13,3	16,3	20,0	21,8	5,1	7,3	4,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0
4	3	0,0	0,0	0,0	0,0	0,0	1,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
4	4	73,3	80,0	62,9	49,1	37,9	26,5	16,9	0,0	3,3	0,0	0,0	0,0	2,9	10,0
4	5	0,0	0,0	0,0	0,0	0,0	0,0	1,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0
4	7	10,0	3,3	11,4	21,8	51,7	60,3	75,4	100,0	96,7	100,0	100,0	100,0	97,1	90,0
4	8	0,0	0,0	0,0	0,0	1,7	2,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0

Analysis of Categories of table legs, Column 3.

Leg	Age in Years,													
Category.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
1	3,3	0,0	2,9	1,8	0,0	1,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2	13,3	16,3	22,9	23,6	5,1	7,3	4,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0
3	0,0	0,0	0,0	0,0	0,0	1,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
4	73,3	80,0	62,9	49,1	41,4	26,5	16,9	0,0	3,3	0,0	0,0	0,0	2,9	10,0
5	0,0	0,0	0,0	0,0	0,0	0,0	1,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0
7	10,0	3,3	11,4	23,6	51,7	60,3	75,4	100,0	96,7	100,0	100,0	100,0	97,1	90,0
8	0,0	0,0	0,0	1,8	1,7	2,9	1,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0

Analysis of Use of Depth Cues, Column 3.

Depth	Age in Years.													
Cue.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
A	3,3	0,0	2,9	1,8	0,0	1,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
B	13,3	16,3	22,9	23,6	5,1	7,3	4,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0
C	73,3	78,0	62,9	49,1	41,4	26,5	16,9	0,0	3,3	0,0	0,0	0,0	2,9	10,0
D	10,0	3,3	11,4	25,5	53,4	63,2	78,5	100,0	96,7	100,0	100,0	100,0	97,1	90,0
E	10,0	3,3	11,4	25,5	53,4	63,2	77,0	100,0	96,7	100,0	100,0	100,0	97,1	90,0

Appendix 8:Cc. Continued.

Analysis of table legs, Column 4.  1

Table Top	Leg So.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
		Age in Years.													
0	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	2	0.0	0.0	0.0	0.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	4	0.0	0.0	0.0	4.0	7.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	4	0.0	0.0	0.0	4.0	3.6	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	6	0.0	0.0	20.0	8.0	3.6	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	7	0.0	0.0	0.0	12.0	17.9	23.7	17.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	8	0.0	0.0	80.0	56.0	53.6	57.9	77.1	100.0	96.7	93.8	100.0	97.4	100.0	100.0
4	2	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	4	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	7	0.0	0.0	0.0	16.0	10.7	7.9	2.9	0.0	3.3	3.1	0.0	2.6	0.0	0.0

Analysis of Categories of table legs, Column 4.

Leg Category	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
	Age in Years.													
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	3.6	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	8.0	10.7	5.3	0.0	0.0	0.0	3.1	0.0	0.0	0.0	0.0
6	0.0	0.0	20.0	8.0	3.6	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	28.0	28.6	31.6	20.0	0.0	3.3	3.1	0.0	2.6	0.0	0.0
8	0.0	0.0	80.0	56.0	53.6	57.9	77.1	100.0	96.7	93.8	100.0	97.4	100.0	100.0

Analysis of Use of Depth Cues, Column 4.

Depth Cue	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
	Age in Years.													
A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B	0.0	0.0	0.0	0.0	3.6	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C	0.0	0.0	20.0	16.0	14.3	10.6	0.0	0.0	0.0	3.1	0.0	0.0	0.0	0.0
D	0.0	0.0	80.0	84.0	82.1	89.5	97.1	100.0	100.0	96.9	100.0	100.0	100.0	100.0
E	0.0	0.0	100.0	92.0	85.7	94.8	97.1	100.0	100.0	96.9	100.0	100.0	100.0	100.0

Appendix 8:Cc. Continued.

Analysis of table legs, Column 5.

Table Top	Leg Gp.	Age in Years, 4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
0	1	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	2	14.3	0.0	0.0	0.0	5.6	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	4	71.4	0.0	23.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0
2	7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	2	0.0	0.0	7.7	9.1	0.0	2.2	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	4	0.0	16.7	30.8	0.0	8.3	6.7	2.3	0.0	0.0	3.1	0.0	0.0	2.9	0.0
3	5	0.0	0.0	0.0	6.1	0.0	4.4	2.3	32.1	16.7	9.4	11.8	10.5	11.4	0.0
3	6	0.0	0.0	0.0	0.0	8.3	2.2	6.8	3.6	0.0	3.1	0.0	0.0	0.0	0.0
3	7	0.0	0.0	0.0	6.0	19.4	22.3	40.9	57.2	70.0	84.2	85.3	84.2	82.9	90.0
3	8	0.0	16.7	0.0	3.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	2	14.3	66.7	38.5	33.3	25.0	13.3	11.4	0.0	3.3	0.0	0.0	0.0	0.0	0.0
4	4	0.0	0.0	0.0	24.2	19.4	28.9	27.3	3.6	6.7	0.0	2.9	2.6	2.9	10.0

Analysis of Categories of table legs, Column 5.

Leg Category	Age in Years, 4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
1	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	14.3	16.7	7.7	12.1	5.6	4.4	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	85.7	83.3	92.3	33.3	33.3	20.0	13.6	0.0	3.3	3.1	0.0	2.6	2.9	0.0
5	0.0	0.0	0.0	6.1	0.0	4.4	2.3	32.1	16.7	9.4	11.8	10.5	11.4	0.0
6	0.0	0.0	0.0	0.0	8.3	2.2	6.8	3.6	0.0	3.1	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	36.4	33.3	44.4	31.8	7.1	10.0	0.0	2.9	2.6	2.9	10.0
8	0.0	0.0	0.0	6.0	19.4	22.3	40.9	57.2	70.0	84.2	85.3	84.2	82.9	90.0

Analysis of Use of Depth Cues, Column 5.

Depth Cue.	Age in Years, 4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
A	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B	14.3	16.7	7.7	12.1	5.6	4.4	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C	85.7	83.3	92.3	33.3	41.6	22.4	20.4	3.6	3.3	6.2	0.0	2.6	2.9	0.0
D	0.0	0.0	0.0	48.5	52.8	71.1	75.0	96.4	96.7	93.8	100.0	97.4	97.1	100.0
E	0.0	0.0	0.0	42.4	61.1	68.9	79.5	67.9	80.0	87.3	88.2	86.8	85.8	100.0

Appendix 8:Cc. Continued.

Analysis of table legs, Column 6. Con.

Table Top	Leg No.	Age in Years, 4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
0	1	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	4	36.7	50.0	48.6	23.6	12.1	11.8	6.2	0.0	0.0	0.0	0.0	2.6	0.0	0.0
1	7	0.0	0.0	0.0	0.0	0.0	1.5	3.1	0.0	3.3	0.0	2.9	0.0	0.0	0.0
2	2	10.0	3.3	5.8	14.5	6.8	8.8	10.8	0.0	0.0	0.0	0.0	0.0	0.0	0.5
2	4	50.0	43.3	31.5	36.4	31.0	19.1	10.8	7.1	3.3	3.1	0.0	2.6	0.0	0.0
2	5	0.0	0.0	0.0	1.8	0.0	2.9	7.7	7.2	3.3	0.0	0.0	2.6	0.0	0.0
2	6	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	7	0.0	3.3	0.0	16.4	17.2	8.8	12.3	0.0	0.0	3.1	0.0	5.3	0.0	0.0
2	8	0.0	0.0	0.0	5.5	5.2	13.3	6.1	3.5	10.0	12.5	0.0	0.0	2.9	10.0
3	2	0.0	0.0	2.9	0.0	1.7	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	0.0	0.0	2.9	0.0
3	5	0.0	0.0	2.9	0.0	5.2	0.0	3.1	3.6	6.7	12.5	17.6	0.0	11.4	15.0
3	6	0.0	0.0	0.0	0.0	1.7	2.9	1.5	0.0	0.0	3.1	0.0	0.0	0.0	0.0
3	7	0.0	0.0	0.0	0.0	6.9	2.9	0.0	0.0	0.0	0.0	2.9	0.0	0.0	5.0
3	8	0.0	0.0	2.9	0.0	6.9	22.1	24.6	50.0	60.0	59.4	80.6	76.3	80.0	55.0
4	4	0.0	0.0	2.9	0.0	0.0	2.9	3.1	7.1	0.0	0.0	0.0	2.6	0.0	0.0
4	7	0.0	0.0	0.0	1.8	5.2	2.9	9.2	21.4	13.3	3.1	5.9	7.9	2.9	10.0

Analysis of Categories of table legs, Column 6.

Leg Category	Age in Years, 4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
1	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	10.0	3.3	8.7	14.5	8.5	8.8	12.3	0.0	0.0	0.0	0.0	0.0	0.0	5.0
4	86.7	93.3	81.1	60.0	43.1	33.8	20.0	14.3	3.3	6.3	0.0	7.9	2.9	0.0
5	0.0	0.0	2.9	1.8	5.2	2.9	10.8	10.8	10.0	12.5	17.6	2.6	11.4	15.0
6	0.0	0.0	2.9	0.0	1.7	2.9	1.5	0.0	0.0	3.1	0.0	0.0	0.0	0.0
7	0.0	3.3	0.0	18.2	29.3	16.2	24.6	21.4	16.7	6.3	11.8	13.2	2.9	15.0
8	0.0	0.0	2.9	5.5	12.1	35.4	30.7	63.5	70.0	71.9	80.6	76.3	82.9	65.0

Analysis of Use of Depth Cues, Column 6.

Depth Cue	Age in Years, 4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
A	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B	10.0	3.3	8.7	14.5	8.5	8.8	12.3	0.0	0.0	0.0	0.0	0.0	0.0	5.0
C	86.7	93.3	84.0	60.0	44.8	36.7	21.5	14.3	3.3	9.4	0.0	7.9	2.9	0.0
D	0.0	3.3	5.7	25.5	46.6	54.4	66.2	85.7	96.7	90.6	100.0	92.1	97.1	95.0
E	0.0	3.3	5.7	23.7	43.1	54.4	56.8	76.9	86.7	81.2	92.4	89.5	85.7	80.0

Appendix 8:Cc. Continued.

Analysis of table legs, Column 7.

Table Top	Leg Gp.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
		Age in Years.													
0	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	2	0.0	0.0	20.0	16.0	10.7	7.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	4	0.0	0.0	20.0	20.0	14.3	7.9	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	7	0.0	0.0	0.0	16.0	10.7	7.9	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0
3	2	0.0	0.0	0.0	20.0	0.0	5.3	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0
3	4	0.0	0.0	40.0	4.0	10.7	10.5	0.0	0.0	0.0	0.0	2.9	2.6	0.0	0.0
3	5	0.0	0.0	0.0	4.0	0.0	2.6	5.8	0.0	0.0	0.0	0.0	0.0	14.3	0.0
3	6	0.0	0.0	0.0	4.0	7.1	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	7	0.0	0.0	0.0	8.0	25.0	18.4	8.6	3.6	0.0	0.0	0.0	0.0	0.0	0.0
3	8	0.0	0.0	0.0	8.0	21.4	34.2	77.1	92.9	100.0	100.0	97.1	97.4	82.8	100.0
4	2	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	4	0.0	0.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	8	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Analysis of Categories of table legs, Column 7.

Leg Category.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
	Age in Years.													
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	20.0	36.0	10.7	15.8	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0
4	0.0	0.0	80.0	24.0	25.0	18.4	2.9	0.0	0.0	0.0	2.9	2.6	0.0	0.0
5	0.0	0.0	0.0	4.0	0.0	2.6	5.8	0.0	0.0	0.0	0.0	0.0	14.3	0.0
6	0.0	0.0	0.0	4.0	7.1	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	24.0	35.7	26.3	11.4	3.6	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	8.0	21.4	36.4	77.1	96.4	100.0	100.0	97.1	97.4	82.8	100.0

Analysis of Use of Depth Cues, Column 7.

Depth Cue.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
	Age in Years.													
A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B	0.0	0.0	20.0	36.0	10.7	15.8	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0
C	0.0	0.0	80.0	28.0	32.1	18.4	5.7	0.0	0.0	0.0	2.9	2.6	0.0	0.0
D	0.0	0.0	0.0	36.0	57.1	65.8	94.3	100.0	100.0	100.0	97.1	97.4	97.1	100.0
E	0.0	0.0	0.0	36.0	64.2	63.3	91.4	100.0	100.0	100.0	97.1	97.4	82.8	100.0

Appendix 8:Cc. Continued.

Analysis of table legs, Column 8. 

Table Top	Leg No.	Age in Years. 4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
0	1	11.1	12.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	4	0.0	12.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	2	0.0	0.0	0.0	0.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	3	11.1	12.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	4	0.0	0.0	0.0	0.0	2.8	4.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	7	0.0	0.0	0.0	5.9	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	2	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	3	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	4	0.0	0.0	8.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	5	0.0	0.0	0.0	8.8	0.0	2.2	2.3	0.0	0.0	0.0	2.9	0.0	0.0	0.0
3	6	0.0	0.0	16.7	0.0	2.8	2.2	2.3	0.0	0.0	3.1	0.0	0.0	0.0	0.0
3	7	0.0	0.0	0.0	5.9	22.2	15.2	7.0	7.1	6.7	0.0	0.0	0.0	0.0	0.0
3	8	0.0	0.0	0.0	8.8	8.3	28.3	37.2	53.6	66.7	75.0	50.0	71.1	82.9	95.0
4	2	0.0	12.5	8.3	2.9	2.8	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	3	55.6	37.5	0.0	5.9	2.8	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	4	11.1	12.5	33.3	20.6	22.2	6.5	2.3	3.6	0.0	0.0	0.0	0.0	0.0	0.0
4	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0
4	7	11.1	0.0	25.0	38.2	33.3	32.6	44.2	35.7	26.7	21.9	41.2	28.9	17.1	5.0
4	8	0.0	0.0	8.3	0.0	0.0	2.2	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Analysis of Categories of table legs, Column 8.

Leg Category.	Age in Years. 4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
1	11.1	12.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	12.5	8.3	5.7	5.6	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	66.7	50.0	8.3	5.9	2.8	2.2	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	11.1	25.0	33.3	29.4	25.0	13.0	4.7	3.6	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.8	0.0	0.0	0.0
6	0.0	0.0	16.7	0.0	2.8	2.2	2.3	0.0	0.0	3.1	0.0	0.0	0.0	0.0
7	11.1	0.0	25.0	50.0	55.6	60.0	61.2	42.9	33.3	21.9	44.1	28.9	17.1	5.0
8	0.0	0.0	8.3	8.8	8.3	30.4	39.5	53.6	66.7	75.0	50.0	71.1	82.9	95.0

Analysis of Use of Depth Cues, Column 8.

Depth Cue.	Age in Years. 4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
A	11.1	12.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B	0.0	12.5	8.3	5.7	5.6	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C	77.8	75.0	58.4	35.3	30.6	17.4	9.3	3.6	0.0	3.1	0.0	0.0	0.0	0.0
D	11.1	0.0	33.3	58.8	63.9	80.4	90.7	96.4	100.0	96.9	100.0	100.0	100.0	100.0
E	11.1	0.0	50.0	58.8	66.7	82.6	92.3	96.4	100.0	100.0	94.2	100.0	100.0	100.0

Appendix 8:Cc. Continued.

Analysis of table legs, Column 9.

Table Top	Leg No.	Age in Years. 4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
0	1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2	2	0,0	0,0	0,0	40,0	17,9	15,8	14,3	32,1	30,0	6,3	8,8	21,1	34,3	50,0
2	4	0,0	0,0	80,0	28,0	39,3	31,6	25,7	17,9	20,0	12,5	29,4	31,6	22,9	30,0
2	5	0,0	0,0	0,0	4,0	3,6	2,6	2,9	21,4	10,0	31,3	17,7	15,8	27,8	10,0
2	7	0,0	0,0	0,0	24,0	32,1	42,1	51,4	10,7	20,0	25,0	23,5	18,4	5,7	0,0
2	8	0,0	0,0	20,0	4,0	3,5	5,3	0,0	17,9	20,0	18,7	11,7	2,6	2,9	5,0
3	5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	2,9	0,0	0,0	0,0
3	7	0,0	0,0	0,0	0,0	3,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
3	8	0,0	0,0	0,0	0,0	0,0	2,6	5,7	0,0	0,0	3,1	5,9	10,5	5,7	5,0
4	7	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	3,1	0,0	0,0	0,0	0,0

Analysis of Categories of table legs, Column 9.

Leg Category.	Age in Years. 4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2	0,0	0,0	0,0	40,0	17,9	15,8	14,3	32,1	30,0	6,3	8,8	21,1	34,3	50,0
4	0,0	0,0	80,0	28,0	39,3	31,6	25,7	17,9	20,0	12,5	29,4	31,6	22,9	30,0
5	0,0	0,0	0,0	4,0	3,6	2,6	2,9	21,4	10,0	31,3	20,6	15,8	27,8	10,0
7	0,0	0,0	0,0	24,0	35,7	42,1	51,4	10,7	20,0	28,1	23,5	18,4	5,7	0,0
8	0,0	0,0	20,0	4,0	3,5	5,3	5,7	17,9	20,0	21,8	17,6	13,1	8,6	10,0

Analysis of Use of Depth Cues, Column 9.

Depth Cue.	Age in Years. 4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
A	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
B	0,0	0,0	0,0	40,0	17,9	15,8	14,3	32,1	30,0	6,3	8,8	21,1	34,3	50,0
C	0,0	0,0	80,0	28,0	39,3	31,6	25,7	17,9	20,0	12,5	29,4	31,6	22,9	30,0
D	0,0	0,0	20,0	32,0	42,9	52,6	60,0	50,0	50,0	81,3	61,8	47,4	42,9	20,0
E	0,0	0,0	20,0	28,0	39,2	47,4	57,1	28,6	40,0	49,9	41,1	31,5	14,3	10,0

Appendix 8:Cc. Continued.

Analysis of table legs, Column 10. 

Table Top	Leg Gp.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
		Age in Years.													
0	1	28.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	4	0.0	0.0	7.1	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	5	0.0	0.0	0.0	3.2	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	6	0.0	20.0	0.0	3.2	8.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	7	0.0	0.0	0.0	29.0	14.7	23.9	11.6	7.1	6.7	0.0	0.0	0.0	0.0	0.0
3	8	71.4	80.0	92.9	64.6	73.6	71.7	88.4	92.9	93.3	100.0	100.0	100.0	100.0	100.0
4	8	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Analysis of Categories of table legs, Coluen 10.

Leg Category	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
	Age in Years.													
1	28.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	7.1	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	3.2	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	20.0	0.0	3.2	8.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	29.0	14.7	23.9	11.6	7.1	6.7	0.0	0.0	0.0	0.0	0.0
8	71.4	80.0	92.9	64.6	73.6	73.9	88.4	92.9	93.3	100.0	100.0	100.0	100.0	100.0

Analysis of Use of Depth Cues, Coluen 10.

Depth Cue	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
	Age in Years.													
A	28.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C	0.0	20.0	7.1	3.2	8.8	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
D	71.4	80.0	92.9	96.8	91.2	97.8	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
E	71.4	100.0	92.9	96.8	97.1	97.8	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Appendix 8:Cc. Continued.

Analysis of table legs, Column 11. 

Table Top	Leg Gp.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
0	1	28.6	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	2	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	4	0.0	0.0	0.0	3.2	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	7	28.6	20.0	14.3	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	2	0.0	0.0	0.0	3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	4	0.0	0.0	7.1	6.5	2.9	4.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	7	14.3	0.0	7.1	19.4	14.7	28.3	23.3	50.0	40.0	21.9	0.0	5.3	22.9	5.0
3	8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	13.3	34.4	20.6	21.1	11.4	25.0
4	2	0.0	0.0	0.0	0.0	2.9	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	4	0.0	20.0	0.0	9.7	26.5	6.5	4.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	7	28.6	40.0	71.4	58.1	44.1	56.5	72.1	46.4	46.7	43.8	79.4	73.7	65.7	70.0
4	8	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Analysis of Categories of table legs, Column 11.

Leg Category.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
1	28.6	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	3.2	5.9	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	20.0	7.1	19.4	32.4	10.9	4.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	71.4	60.0	92.9	77.4	61.8	84.8	95.3	96.4	86.7	65.6	79.4	78.9	88.6	75.0
8	0.0	0.0	0.0	0.0	0.0	2.2	0.0	3.6	13.3	34.4	20.6	21.1	11.4	25.0

Analysis of Use of Depth Cues, Column 11.

Depth Cue.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
A	28.6	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B	0.0	0.0	0.0	3.2	5.9	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C	0.0	20.0	7.1	19.4	32.4	10.9	4.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
D	71.4	60.0	92.9	77.4	61.8	87.0	95.3	100.0	100.0	100.0	100.0	100.0	100.0	100.0
E	71.4	60.0	92.9	77.4	61.8	87.0	95.3	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Appendix 8:Cc. Continued.

Analysis of table legs, Column 12.

Table Top	Leg No.	4	5	6	7	8	9	10	11	12	13	14	15	16	>20
0	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	0.0	0.0	0.0	0.0
1	4	0.0	0.0	0.0	4.0	0.0	0.0	0.0	10.7	3.3	3.1	5.9	0.0	5.7	15.0
1	7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0
2	2	0.0	0.0	20.0	32.0	21.4	13.2	2.9	7.1	3.3	0.0	0.0	2.6	2.9	0.0
2	4	0.0	0.0	60.0	32.0	35.7	28.9	11.4	0.0	0.0	0.0	0.0	2.6	0.0	0.0
2	5	0.0	0.0	0.0	0.0	3.6	0.0	2.9	0.0	3.3	0.0	0.0	0.0	2.9	5.0
2	7	0.0	0.0	0.0	20.0	17.9	26.3	17.1	3.6	3.3	6.3	0.0	2.6	2.9	0.0
2	8	0.0	0.0	0.0	0.0	3.5	5.3	0.0	14.3	0.0	6.3	0.0	2.6	0.0	0.0
3	2	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9	0.0	2.9	0.0
3	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7	33.3	15.6	11.8	0.0	14.3	10.0
3	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.3	0.0	0.0	0.0	0.0
3	7	0.0	0.0	0.0	4.0	7.1	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	8	0.0	0.0	0.0	0.0	0.0	10.5	34.3	39.3	53.4	56.3	55.8	78.9	54.3	55.0
4	2	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0
4	4	0.0	0.0	0.0	0.0	3.6	0.0	8.6	3.6	6.7	0.0	0.0	0.0	0.0	5.0
4	7	0.0	0.0	0.0	8.0	7.1	7.9	20.0	7.1	13.3	3.1	17.6	7.9	14.3	10.0
4	8	0.0	0.0	0.0	0.0	0.0	2.6	0.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0

Analysis of Categories of table legs, Column 12.

Leg Category	4	5	6	7	8	9	10	11	12	13	14	15	16	>20
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	20.0	32.0	21.4	15.8	5.8	7.1	3.3	3.1	0.0	5.2	2.9	0.0
4	0.0	0.0	60.0	36.0	39.3	28.9	20.0	14.3	10.0	3.1	11.8	2.6	8.6	20.0
5	0.0	0.0	0.0	0.0	3.6	0.0	2.9	10.7	16.6	15.6	11.8	0.0	17.2	10.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.3	0.0	0.0	0.0	0.0
7	0.0	0.0	20.0	32.0	32.1	36.8	37.1	10.7	16.7	9.4	20.6	10.5	17.1	15.0
8	0.0	0.0	0.0	0.0	3.5	18.4	34.3	57.2	53.4	62.6	55.8	81.6	54.3	55.0

Analysis of Use of Depth Cues, Column 12.

Depth Cue	4	5	6	7	8	9	10	11	12	13	14	15	16	>20
A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B	0.0	0.0	20.0	32.0	21.4	15.8	5.8	7.1	3.3	3.1	0.0	5.2	2.9	0.0
C	0.0	0.0	60.0	36.0	39.3	28.9	20.0	14.3	10.0	9.4	11.8	2.6	8.6	20.0
D	0.0	0.0	20.0	32.0	39.3	55.3	74.3	78.6	86.7	87.5	88.2	92.1	88.6	80.0
E	0.0	0.0	20.0	32.0	35.6	55.3	71.4	67.9	70.3	78.3	76.4	92.1	71.4	70.0

Appendix 8:Cc. Continued.

Analysis of table legs, Column 13. 

Table Top	Leg No.	Age in Years. 4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
0	1	14.3	16.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	2	0.0	0.0	0.0	0.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	4	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	0.0	0.0	0.0	0.0
4	4	0.0	16.7	15.4	12.1	22.2	4.4	4.5	0.0	0.0	0.0	0.0	0.0	2.9	0.0
4	7	85.7	66.7	84.6	87.9	75.0	91.1	95.5	100.0	100.0	96.9	100.0	100.0	97.1	95.0
4	8	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0

Analysis of Categories of table legs, Column 13.

Leg Category.	Age in Years. 4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
1	14.3	16.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	2.8	0.0	0.0	0.0	0.0	3.1	0.0	0.0	0.0	0.0
4	0.0	16.7	15.4	12.1	22.2	6.7	4.5	0.0	0.0	0.0	0.0	0.0	2.9	0.0
7	85.7	66.7	84.6	87.9	75.0	91.1	95.5	100.0	100.0	96.9	100.0	100.0	97.1	95.0
8	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0

Analysis of Use of Depth Cues, Column 13.

Depth Cue.	Age in Years. 4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
A	14.3	16.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B	0.0	0.0	0.0	0.0	2.8	0.0	0.0	0.0	0.0	3.1	0.0	0.0	0.0	0.0
C	0.0	16.7	15.4	12.1	22.2	6.7	4.5	0.0	0.0	0.0	0.0	0.0	2.9	0.0
D	85.7	66.7	84.6	87.9	75.0	93.3	95.5	100.0	100.0	96.9	100.0	100.0	97.1	100.0
E	85.7	66.7	84.6	87.9	75.0	93.3	95.5	100.0	100.0	96.9	100.0	100.0	97.1	100.0

Appendix 8:Cc. Continued.

Analysis of table legs, Column 14.

Table Top	Leg No.	Age in Years, 4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
0	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	2	0.0	0.0	0.0	28.0	25.0	13.2	8.6	25.0	26.7	3.1	11.8	15.8	37.2	65.0
2	4	0.0	0.0	60.0	36.0	42.9	21.1	20.0	25.0	16.7	15.6	26.5	34.2	22.9	25.0
2	5	0.0	0.0	0.0	0.0	3.6	10.5	11.4	17.8	10.0	31.3	44.7	18.5	28.5	10.0
2	6	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	7	0.0	0.0	20.0	32.0	28.6	47.4	45.7	17.9	16.7	37.5	23.5	18.4	11.4	0.0
2	8	0.0	0.0	20.0	0.0	0.0	7.9	11.5	14.3	30.0	12.5	20.6	7.8	0.0	0.0
3	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0
3	8	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	2.6	0.0	0.0
4	7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0

Analysis of Categories of table legs, Column 14.

Leg Category	Age in Years, 4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	28.0	25.0	13.2	8.6	25.0	26.7	3.1	11.8	15.8	37.2	65.0
4	0.0	0.0	60.0	36.0	42.9	21.1	20.0	25.0	16.7	15.6	26.5	34.2	22.9	25.0
5	0.0	0.0	0.0	0.0	3.6	10.5	11.4	17.8	10.0	31.3	17.6	18.5	28.5	10.0
6	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	20.0	32.0	28.6	47.4	45.7	17.9	16.7	37.5	23.5	21.1	11.4	0.0
8	0.0	0.0	20.0	0.0	0.0	7.9	14.4	14.3	30.0	12.5	20.6	10.4	0.0	0.0

Analysis of Use of Depth Cues, Column 14.

Depth Cue	Age in Years, 4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B	0.0	0.0	0.0	28.0	25.0	13.2	8.6	25.0	26.7	3.1	11.8	15.8	37.2	65.0
C	0.0	0.0	60.0	40.0	42.9	21.1	20.0	25.0	16.7	15.6	26.5	34.2	22.9	25.0
D	0.0	0.0	40.0	32.0	32.1	65.8	71.4	50.0	56.7	81.3	61.8	50.0	40.0	10.0
E	0.0	0.0	40.0	36.0	32.1	55.3	60.1	32.2	46.7	50.0	44.1	28.9	11.4	0.0

Appendix 8:Cc. Continued.

Analysis of table legs, Column 15.

Table Top	Leg No.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
		Age in Years.													
0	1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
1	4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	11,1
2	2	0,0	0,0	0,0	8,3	7,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2	4	0,0	0,0	0,0	25,0	28,6	5,0	5,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2	5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	5,9	0,0	0,0	0,0	0,0
2	7	0,0	0,0	0,0	25,0	0,0	5,0	5,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2	8	0,0	0,0	50,0	0,0	0,0	5,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
3	5	0,0	0,0	0,0	0,0	7,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
3	8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	5,3	0,0	0,0
4	2	0,0	0,0	0,0	0,0	0,0	5,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
4	4	0,0	0,0	50,0	8,3	21,4	25,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
4	7	0,0	0,0	0,0	33,3	35,7	55,0	88,9	100,0	100,0	94,1	100,0	94,7	100,0	88,9

Analysis of Categories of table legs, Column 15.

Leg Category	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
	Age in Years.													
1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2	0,0	0,0	0,0	8,3	7,1	5,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
4	0,0	0,0	50,0	33,3	50,0	30,0	5,6	0,0	0,0	0,0	0,0	0,0	0,0	11,1
5	0,0	0,0	0,0	0,0	7,1	0,0	0,0	0,0	0,0	5,9	0,0	0,0	0,0	0,0
7	0,0	0,0	0,0	58,3	35,7	60,0	94,9	100,0	100,0	94,1	100,0	94,7	100,0	88,9
8	0,0	0,0	50,0	0,0	0,0	5,0	0,0	0,0	0,0	0,0	0,0	5,3	0,0	0,0

Analysis of Use of Depth Cues, Column 15.

Depth Cue	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
	Age in Years.													
A	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
B	0,0	0,0	0,0	8,3	7,1	5,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
C	0,0	0,0	50,0	33,3	50,0	30,0	5,6	0,0	0,0	0,0	0,0	0,0	0,0	11,1
D	0,0	0,0	50,0	58,3	42,9	65,0	94,9	100,0	100,0	100,0	100,0	100,0	100,0	88,9
E	0,0	0,0	50,0	58,3	35,7	65,0	94,9	100,0	100,0	94,1	100,0	100,0	100,0	88,9

Appendix 8:Cc. Continued.

Analysis of table legs, Column 16.

Table Top	Leg No.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
		Age in Years.													
0	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	2	0.0	0.0	0.0	0.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	4	0.0	0.0	0.0	8.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	7	0.0	0.0	0.0	4.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	2	0.0	0.0	0.0	16.0	0.0	13.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	4	0.0	0.0	60.0	20.0	21.4	21.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	5	0.0	0.0	20.0	4.0	3.6	5.2	2.9	0.0	0.0	0.0	0.0	0.0	5.7	15.0
3	6	0.0	0.0	20.0	12.0	7.1	0.0	5.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	7	0.0	0.0	0.0	12.0	25.0	13.2	11.4	0.0	3.3	0.0	0.0	0.0	0.0	0.0
3	8	0.0	0.0	0.0	8.0	21.4	39.5	74.2	100.0	96.7	100.0	100.0	100.0	94.3	85.0
4	2	0.0	0.0	0.0	4.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	4	0.0	0.0	0.0	0.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	7	0.0	0.0	0.0	12.0	7.1	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Analysis of Categories of table legs, Column 16.

Leg Category	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
	Age in Years.													
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	20.0	7.1	13.2	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	60.0	28.0	28.6	21.1	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	20.0	4.0	3.6	5.2	2.9	0.0	0.0	0.0	0.0	0.0	5.7	15.0
6	0.0	0.0	20.0	12.0	7.1	0.0	5.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	28.0	32.1	21.1	11.4	0.0	3.3	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	8.0	21.4	39.5	74.2	100.0	96.7	100.0	100.0	100.0	94.3	85.0

Analysis of Use of Depth Cues, Column 16.

Depth Cue	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
	Age in Years.													
A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B	0.0	0.0	0.0	20.0	7.1	13.2	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C	0.0	0.0	80.0	40.0	35.7	21.1	8.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
D	0.0	0.0	20.0	40.0	57.1	65.8	88.6	100.0	100.0	100.0	100.0	100.0	100.0	100.0
E	0.0	0.0	20.0	48.0	60.6	60.6	91.3	100.0	100.0	100.0	100.0	100.0	94.3	85.0

Appendix 8:Cc. Continued.

Analysis of table legs, Column 17.

Table Top	Leg No.	Age in Years, 4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
0	1	14.3	27.3	0.0	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	2	14.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	4	57.1	0.0	9.1	12.5	2.8	4.4	5.0	0.0	0.0	3.1	0.0	2.6	8.6	25.0
1	7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	3.1	0.0	0.0	0.0	0.0
2	2	14.3	18.2	36.4	25.0	11.1	20.0	20.0	14.3	10.0	6.3	2.9	5.3	2.9	10.0
2	4	0.0	18.2	45.5	28.1	41.7	24.4	10.0	7.1	6.7	0.0	5.9	5.3	0.0	0.0
2	5	0.0	0.0	0.0	3.1	2.8	0.0	5.0	10.7	3.3	9.4	2.9	2.6	0.0	0.0
2	7	0.0	9.1	9.1	15.6	19.4	26.7	20.0	14.3	6.7	12.5	5.9	7.9	0.0	0.0
2	8	0.0	0.0	0.0	0.0	5.5	6.7	2.5	14.3	10.0	6.2	3.0	0.0	0.0	0.0
3	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0
3	5	0.0	0.0	0.0	3.1	2.8	0.0	0.0	10.7	10.0	12.5	17.6	5.3	2.9	0.0
3	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	0.0	0.0	0.0	0.0
3	7	0.0	0.0	0.0	0.0	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	8	0.0	0.0	0.0	3.2	2.8	13.3	20.0	17.9	43.3	37.5	38.3	65.8	60.0	55.0
4	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0
4	4	0.0	27.3	0.0	6.3	2.8	0.0	2.5	3.6	3.3	0.0	0.0	0.0	0.0	0.0
4	7	0.0	0.0	0.0	0.0	2.8	4.4	15.0	7.1	3.3	6.3	20.6	5.3	22.9	10.0

Analysis of Categories of table legs, Column 17.

Leg Category.	Age in Years, 4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
1	14.3	27.3	0.0	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	28.6	18.2	36.4	25.0	11.1	20.0	20.0	14.3	10.0	6.3	5.9	5.3	5.8	10.0
4	57.1	45.5	54.5	46.9	47.2	28.9	17.5	10.7	10.0	3.1	5.9	7.9	8.6	25.0
5	0.0	0.0	0.0	6.2	5.6	0.0	5.0	21.4	13.3	21.9	20.5	7.9	2.9	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	0.0	0.0	0.0	0.0
7	0.0	9.1	9.1	15.6	27.8	31.1	35.0	21.4	13.3	21.9	26.5	13.2	22.9	10.0
8	0.0	0.0	0.0	3.2	8.3	20.0	27.5	32.2	53.3	43.7	41.3	65.8	60.0	55.0

Analysis of Use of Depth Cues, Column 17.

Depth Cue.	Age in Years, 4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
A	14.3	27.3	0.0	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B	28.6	18.2	36.4	25.0	11.1	20.0	20.0	14.3	10.0	6.3	5.9	5.3	5.8	10.0
C	57.1	45.5	54.5	46.9	47.2	28.9	17.5	10.7	10.0	6.2	5.9	7.9	8.6	25.0
D	0.0	9.1	9.1	25.0	41.7	51.1	62.5	75.0	80.0	87.5	88.2	86.8	85.7	65.0
E	0.0	9.1	9.1	18.8	46.1	51.1	62.5	53.6	66.6	68.7	67.8	79.0	82.9	65.0

Appendix 8:Cc. Continued.

Analysis of table legs, Column 18. 

Table Top	Leg No.	4	5	6	7	8	9	10	11	12	13	14	15	16	>20
0	1	18.8	7.1	0.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	3	6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	4	6.3	0.0	5.0	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	7	0.0	0.0	0.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	8	12.5	21.4	15.0	7.1	2.2	3.8	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	4	0.0	28.6	0.0	0.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	5	0.0	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	6	0.0	7.1	0.0	4.8	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	7	0.0	0.0	0.0	16.7	4.5	18.9	9.6	10.7	3.3	0.0	0.0	0.0	2.9	0.0
3	8	56.3	35.7	80.0	69.0	79.5	73.6	86.5	89.3	96.7	100.0	100.0	100.0	97.1	100.0

Analysis of Categories of table legs, Column 18.

Leg Category	4	5	6	7	8	9	10	11	12	13	14	15	16	>20
1	18.8	7.1	0.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	6.3	28.6	5.0	2.4	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	7.1	0.0	4.8	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	16.7	4.5	20.8	9.6	10.7	3.3	0.0	0.0	0.0	2.9	0.0
8	68.8	57.1	95.0	76.2	81.9	77.4	88.5	89.3	96.7	100.0	100.0	100.0	97.1	100.0

Analysis of Use of Depth Cues, Column 18.

Depth Cue	4	5	6	7	8	9	10	11	12	13	14	15	16	>20
A	18.8	7.1	0.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C	12.5	28.6	5.0	7.2	11.4	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
D	68.8	57.1	95.0	92.9	88.6	98.1	98.1	100.0	100.0	100.0	100.0	100.0	100.0	100.0
E	68.8	64.2	95.0	97.7	97.8	98.1	98.1	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Appendix 8:Cc. Continued.

Analysis of table legs, Column 19. 

Table Top	Leg No.	Age in Years, 4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
0	1	85.7	27.3	18.2	3.1	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	4	0.0	0.0	0.0	0.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	4	0.0	27.3	9.1	3.1	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	5	0.0	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	6	0.0	9.1	18.2	6.3	8.3	6.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	7	0.0	0.0	0.0	21.9	13.9	26.7	12.5	7.1	3.3	0.0	0.0	0.0	0.0	0.0
3	8	14.3	27.3	54.5	65.6	75.0	62.2	87.5	92.9	96.7	100.0	100.0	100.0	100.0	100.0

Analysis of Categories of table legs, Column 19.

Leg Category.	Age in Years, 4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
1	85.7	27.3	18.2	3.1	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	27.3	9.1	3.1	2.8	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	9.1	18.2	6.3	8.3	6.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	21.9	13.9	26.7	12.5	7.1	3.3	0.0	0.0	0.0	0.0	0.0
8	14.3	27.3	54.5	65.6	75.0	62.2	87.5	92.9	96.7	100.0	100.0	100.0	100.0	100.0

Analysis of Use of Depth Cues, Column 19.

Depth Cue.	Age in Years, 4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
A	85.7	27.3	18.2	3.1	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C	0.0	36.4	27.3	9.4	11.1	8.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
D	14.3	36.4	54.5	87.5	88.9	88.9	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
E	14.3	36.4	72.7	93.8	97.2	95.6	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Appendix 8:Cc. Continued.

Analysis of table legs, Column 20.

Table Top	Leg No	Age in Years. 4	5	6	7	8	9	10	11	12	13	14	15	16	>20
0	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	2.6	0.0	15.0
2	2	0.0	0.0	0.0	24.0	21.5	18.4	17.1	28.6	33.3	3.1	5.9	18.4	37.2	55.0
2	4	0.0	0.0	80.0	36.0	39.3	26.3	8.6	21.4	20.0	15.6	23.5	34.2	28.6	25.0
2	5	0.0	0.0	20.0	0.0	3.6	7.9	11.4	17.9	10.0	31.3	20.6	10.6	22.9	0.0
2	7	0.0	0.0	0.0	32.0	25.0	36.8	48.6	14.3	13.3	34.4	20.6	18.4	5.7	5.0
2	8	0.0	0.0	0.0	8.0	3.5	5.3	14.3	14.2	23.3	12.5	11.8	5.2	0.0	0.0
3	2	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9	0.0	0.0	0.0
3	8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	0.0	3.1	5.9	10.5	5.7	0.0
4	7	0.0	0.0	0.0	0.0	7.1	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0
4	8	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Analysis of Categories of table legs, Column 20.

Leg Category	Age in Years. 4	5	6	7	8	9	10	11	12	13	14	15	16	>20
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	24.0	21.5	21.0	17.1	28.6	33.3	3.1	5.9	18.4	37.2	55.0
4	0.0	0.0	80.0	36.0	39.3	26.3	8.6	21.4	20.0	15.6	26.5	36.8	28.6	40.0
5	0.0	0.0	20.0	0.0	3.6	7.9	11.4	17.9	10.0	31.3	26.5	10.6	22.9	0.0
7	0.0	0.0	0.0	32.0	32.1	36.8	48.6	14.3	13.3	34.4	23.5	18.4	5.7	5.0
8	0.0	0.0	0.0	8.0	3.5	7.9	14.3	17.8	23.3	15.6	17.5	15.7	5.7	0.0

Analysis of Use of Depth Cues, Column 20.

Depth Cue	Age in Years. 4	5	6	7	8	9	10	11	12	13	14	15	16	>20
A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B	0.0	0.0	0.0	24.0	21.5	21.0	17.1	28.6	33.3	3.1	5.9	18.4	37.2	55.0
C	0.0	0.0	80.0	36.0	39.3	26.3	8.6	21.4	20.0	15.6	26.5	36.8	28.6	40.0
D	0.0	0.0	20.0	40.0	39.3	52.6	74.3	50.0	46.7	81.3	67.6	44.7	34.3	5.0
E	0.0	0.0	0.0	40.0	35.6	44.7	62.9	32.1	36.6	50.0	40.1	34.1	11.4	5.0

Appendix 8:Cc. Continued.

Analysis of table legs, Column 21.

Table Top	Leg Gp.	Age in Years, 4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
0	1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2	2	0,0	0,0	20,0	0,0	3,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2	4	0,0	0,0	0,0	8,0	7,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2	5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	3,1	0,0	0,0	0,0	0,0
2	7	0,0	0,0	0,0	4,0	0,0	5,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2	8	0,0	0,0	0,0	0,0	0,0	2,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
3	2	0,0	0,0	0,0	4,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
3	4	0,0	0,0	20,0	8,0	3,6	2,6	2,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0
3	5	0,0	0,0	0,0	0,0	0,0	5,3	0,0	0,0	0,0	0,0	0,0	0,0	2,9	0,0
3	7	0,0	0,0	0,0	0,0	3,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
3	8	0,0	0,0	0,0	0,0	0,0	2,6	0,0	0,0	3,3	0,0	0,0	2,6	2,8	5,0
4	2	0,0	0,0	0,0	16,0	7,1	13,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	5,0
4	4	0,0	0,0	60,0	24,0	32,1	13,2	8,6	0,0	0,0	0,0	0,0	0,0	0,0	5,0
4	5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	3,1	0,0	0,0	0,0	0,0
4	7	0,0	0,0	0,0	32,0	42,9	52,6	85,7	100,0	96,7	93,8	100,0	97,4	91,4	85,0
4	8	0,0	0,0	0,0	4,0	0,0	2,6	2,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0

Analysis of Categories of table legs, Column 21.

Leg Category.	Age in Years, 4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2	0,0	0,0	20,0	20,0	10,7	13,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	5,0
4	0,0	0,0	80,0	40,0	42,9	15,8	11,4	0,0	0,0	0,0	0,0	0,0	2,9	5,0
5	0,0	0,0	0,0	0,0	0,0	5,3	0,0	0,0	0,0	6,2	0,0	0,0	0,0	0,0
7	0,0	0,0	0,0	36,0	46,4	67,9	85,7	100,0	96,7	93,8	100,0	97,4	91,4	85,0
8	0,0	0,0	0,0	4,0	0,0	7,8	2,9	0,0	3,3	0,0	0,0	2,6	2,8	5,0

Analysis of Use of Depth Cues, Column 21.

Depth Cue.	Age in Years, 4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
A	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
B	0,0	0,0	20,0	20,0	10,7	13,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	5,0
C	0,0	0,0	80,0	40,0	42,9	15,8	11,4	0,0	0,0	0,0	0,0	0,0	2,9	5,0
D	0,0	0,0	0,0	40,0	46,4	71,1	88,6	100,0	100,0	100,0	100,0	100,0	97,1	90,0
E	0,0	0,0	0,0	40,0	46,4	65,7	88,6	100,0	100,0	93,8	100,0	100,0	94,2	90,0

Appendix 8:Cc. Continued.

Analysis of table legs, Column 22. 

Table Top	Leg No.	4	5	6	7	8	9	10	11	12	13	14	15	16	>20
		Age in Years.													
0	1	3.3	0.0	2.9	3.6	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	2	43.4	20.0	34.3	20.0	10.3	14.7	3.1	0.0	0.0	0.0	0.0	0.0	0.0	5.0
3	3	0.0	6.7	5.7	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	4	36.7	53.3	20.0	31.0	17.2	5.9	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	5	6.7	6.7	14.3	3.6	15.6	5.9	7.7	0.0	0.0	0.0	0.0	0.0	5.7	5.0
3	6	3.3	3.3	11.4	5.5	15.5	5.9	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	7	3.3	3.3	0.0	12.7	13.8	19.1	3.1	3.6	0.0	0.0	0.0	0.0	0.0	0.0
3	8	3.3	6.6	11.4	22.7	22.9	47.0	76.7	94.6	100.0	100.0	100.0	100.0	94.3	90.0

Analysis of Categories of table legs, Column 22.

Leg Category	4	5	6	7	8	9	10	11	12	13	14	15	16	>20
	Age in Years.													
1	3.3	0.0	2.9	3.6	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	43.4	20.0	34.3	20.0	10.3	14.7	3.1	0.0	0.0	0.0	0.0	0.0	0.0	5.0
3	0.0	6.7	5.7	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	36.7	53.3	20.0	31.0	17.2	5.9	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	6.7	6.7	14.3	3.6	15.6	5.9	7.7	0.0	0.0	0.0	0.0	0.0	5.7	5.0
6	3.3	3.3	11.4	5.5	15.5	5.9	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	3.3	3.3	0.0	12.7	13.8	19.1	3.1	3.6	0.0	0.0	0.0	0.0	0.0	0.0
8	3.3	6.6	11.4	22.7	22.9	47.0	76.7	94.6	100.0	100.0	100.0	100.0	94.3	90.0

Analysis of Use of Depth Cues, Column 22.

Depth Cue	4	5	6	7	8	9	10	11	12	13	14	15	16	>20
	Age in Years.													
A	3.3	0.0	2.9	3.6	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B	43.4	20.0	34.3	20.0	10.3	14.7	3.1	0.0	0.0	0.0	0.0	0.0	0.0	5.0
C	40.0	63.3	37.1	36.5	33.3	11.8	9.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
D	13.3	16.7	25.7	40.0	55.1	72.1	87.7	100.0	100.0	100.0	100.0	100.0	100.0	95.0
E	9.9	13.5	22.8	40.9	52.2	72.1	84.4	100.0	100.0	100.0	100.0	100.0	94.3	90.0

Appendix 8:Cc. Continued.

Analysis of table legs, Column 23.

Table Top	Leg No.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
0	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	2	0.0	0.0	0.0	0.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	4	0.0	0.0	0.0	4.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	2	0.0	0.0	0.0	12.0	9.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	4	0.0	0.0	20.0	8.0	10.7	2.6	2.9	0.0	0.0	0.0	2.9	0.0	0.0	0.0
3	5	0.0	0.0	0.0	0.0	3.6	2.6	0.0	10.7	10.0	15.6	14.7	2.6	8.6	10.0
3	6	0.0	0.0	20.0	4.0	0.0	0.0	2.9	0.0	10.0	6.3	0.0	0.0	0.0	0.0
3	7	0.0	0.0	0.0	8.0	10.7	10.5	8.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	8	0.0	0.0	0.0	8.0	7.1	21.1	45.7	35.7	53.3	65.7	52.9	65.8	68.5	80.0
4	2	0.0	0.0	0.0	8.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	4	0.0	0.0	60.0	16.0	25.0	13.2	14.3	7.1	0.0	0.0	0.0	2.6	0.0	0.0
4	7	0.0	0.0	0.0	32.0	28.6	39.5	22.9	42.9	26.7	12.5	29.4	28.9	22.9	10.0
4	8	0.0	0.0	0.0	0.0	0.0	5.3	2.9	3.6	0.0	0.0	0.0	0.0	0.0	0.0

Analysis of Categories of table legs, Column 23.

Leg Category.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	20.0	13.3	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	80.0	28.0	35.7	18.4	17.1	7.1	0.0	0.0	2.9	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	3.6	2.6	0.0	10.7	10.0	15.6	14.7	2.6	8.6	10.0
6	0.0	0.0	20.0	4.0	0.0	0.0	2.9	0.0	10.0	6.3	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	40.0	39.3	50.0	31.4	42.9	26.7	12.5	29.4	28.9	22.9	10.0
8	0.0	0.0	0.0	8.0	7.1	26.4	48.6	39.3	53.3	65.7	52.9	65.8	68.5	80.0

Analysis of Use of Depth Cues, Column 23.

Depth Cue.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B	0.0	0.0	0.0	20.0	13.3	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C	0.0	0.0	100.0	32.0	35.7	18.4	20.0	7.1	10.0	6.3	2.9	2.6	0.0	0.0
D	0.0	0.0	0.0	48.0	50.0	78.9	80.0	92.9	90.0	93.8	97.1	97.4	100.0	100.0
E	0.0	0.0	20.0	52.0	46.4	76.4	82.9	82.2	90.0	84.5	82.3	94.7	91.4	90.0

Appendix 8:Cc. Continued.

Analysis of table legs, Column 24. 

Table Typ	Leg No	Age in Years. 4	5	6	7	8	9	10	11	12	13	14	15	16	>20
0	1	57.1	20.0	14.3	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	7	14.3	40.0	7.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	2	0.0	0.0	0.0	0.0	5.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	4	0.0	0.0	0.0	6.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	2	0.0	0.0	7.1	3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	4	0.0	40.0	7.1	12.9	·35.3	6.5	4.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	7	28.6	0.0	64.3	77.4	58.8	89.1	95.3	100.0	100.0	100.0	100.0	100.0	100.0	100.0
4	8	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Analysis of Categories of table legs, Column 24.

Leg Category.	Age in Years. 4	5	6	7	8	9	10	11	12	13	14	15	16	>20
1	57.1	20.0	14.3	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	7.1	3.2	5.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	40.0	7.1	19.4	35.3	6.5	4.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	42.9	40.0	71.4	77.4	58.8	89.1	95.3	100.0	100.0	100.0	100.0	100.0	100.0	100.0
8	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Analysis of Use of Depth Cues, Column 24.

Depth Cue.	Age in Years. 4	5	6	7	8	9	10	11	12	13	14	15	16	>20
A	57.1	20.0	14.3	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B	0.0	0.0	7.1	3.2	5.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C	0.0	40.0	7.1	19.4	35.3	6.5	4.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
D	42.9	40.0	71.4	77.4	58.8	91.3	95.3	100.0	100.0	100.0	100.0	100.0	100.0	100.0
E	42.9	40.0	71.4	77.4	58.8	91.3	95.3	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Appendix 8:Cc. Continued.

Analysis of table legs, Column 25 Choice ·

Table Top	Leg No.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
0	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	2	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0
2	4	10.0	6.6	5.8	1.8	0.0	1.5	0.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0
2	5	0.0	0.0	0.0	0.0	0.0	0.0	1.5	3.6	0.0	0.0	2.9	0.0	0.0	0.0
2	7	0.0	3.3	2.9	0.0	0.0	0.0	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	8	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	2	13.3	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	3	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	4	16.7	23.4	2.9	3.6	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0
3	5	0.0	3.3	2.9	1.8	6.7	0.0	1.5	3.6	6.7	3.1	0.0	0.0	2.9	10.0
3	6	3.3	3.3	5.7	1.8	5.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	7	3.3	0.0	0.0	14.5	3.3	15.2	1.5	0.0	0.0	3.1	0.0	0.0	0.0	0.0
3	8	50.0	40.0	74.2	72.8	81.7	71.2	83.1	67.9	80.0	87.5	76.5	86.8	77.1	65.0
4	2	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	4	3.3	10.0	0.0	0.0	1.7	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	7	0.0	3.3	2.9	7.3	1.7	6.1	3.1	21.4	13.3	6.3	17.6	13.2	20.0	15.0

Analysis of Categories of table legs, Column 25.

Leg Category.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	16.6	0.0	0.0	0.0	0.0	1.5	1.5	0.0	0.0	0.0	0.0	0.0	0.0	10.0
3	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	30.0	40.0	8.7	5.4	1.7	3.0	0.0	3.6	0.0	0.0	2.9	0.0	0.0	0.0
5	0.0	3.3	2.9	1.8	6.7	0.0	3.0	7.2	6.7	3.1	2.9	0.0	2.9	10.0
6	3.3	3.3	5.7	1.8	5.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	3.3	6.6	5.8	21.8	5.0	21.3	9.2	21.4	13.3	9.4	17.6	13.2	20.0	15.0
8	50.0	40.0	74.2	72.8	81.7	71.2	84.6	67.9	80.0	87.5	76.5	86.8	77.1	65.0

Analysis of Use of Depth Cues, Column 25

Depth Cue.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	>20.
A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B	16.6	0.0	0.0	0.0	0.0	1.5	1.5	0.0	0.0	0.0	0.0	0.0	0.0	10.0
C	36.6	40.0	14.4	7.2	6.7	6.0	0.0	3.6	0.0	0.0	2.9	0.0	0.0	0.0
D	53.3	49.9	82.9	96.4	92.4	92.5	96.8	96.1	100.0	100.0	97.1	100.0	100.0	90.0
E	56.6	49.9	85.7	96.4	90.7	95.5	93.8	88.9	93.3	96.9	94.2	100.0	97.1	80.0

Appendix 8:D.

Detailed analyses of proportions of response, with age, of stimuli in Groups C to I.

In this appendix responses to the stimuli in groups C to I (as outlined in the introduction to Appendices 8) are compared within each group. A truncated version of this appendix is presented in Chapter 8.

Appendix 8:D.

1) Detailed analysis of proportions of response, with age, of stimuli in Group C.

This group is comprised of two table types, nos. 12 [—] and 17 [┌─┐] in Figure 8:1. The proportions of response, with age, both on type of table top and type of depth cue produced, were compared across the two figures by a series of Kolmogorov Smirnov two sample, one tailed χ^2 approximation tests. These tests failed to find any significant differences in response to the two stimuli for the oblique response, or the use of ground line, ground plane, or partial occlusion, but did show significant differences in the production of the orthographic, vertical oblique, and perspective table tops, and in the production of no ground plane. Comparison of Stimulus no. 12 vs. Stimulus no. 17 = Orthographic:- $K\chi^2 = 9.57$, df = 2, $p < 0.01$; Vertical Oblique:- $K\chi^2 = 32.0$, df = 2, $p < 0.001$; Oblique:- $K\chi^2 = 1.5$, df = 2, $p > 0.05$; Perspective:- $K\chi^2 = 8.74$, df = 2, $p < 0.02$; No ground line:- $K\chi^2 = 14.68$, df = 2, $p < 0.001$; Ground line:- $K\chi^2 = 1.04$, df = 2, $p > 0.05$; Ground plane:- $K\chi^2 = 0.6$, df = 2, $p > 0.05$; Partial Occlusion:- $K\chi^2 = 1.3$, df = 2, $p > 0.05$.

The main areas of difference between the two stimuli appear to be in the proportions, with age, of the vertical oblique and no ground line responses. It can be argued that differences between the two stimuli in orthographic and perspective responses are, to a certain extent, an artifact of the study. Because the data are proportional, a difference in response on one measure necessitates differences on other measures. If the difference is sufficiently strong on one measure, the other differences may well be found significant also. The fact that oblique is the only table top measure on which no significant differences are evident is of interest. It reinforces arguments put forward in earlier chapters about the uniqueness of the oblique response.

Figure 8:D1 illustrates that ~~S~~stimulus 17 elicits significantly more vertical oblique and no ground line responses from older children

Key:- Stimulus 12. [ ] ——— Vertical Oblique — — No ground line.
Stimulus 17. [ ] - - - - Vertical Oblique ·········· No ground line.

Figure 8:D1. *A comparison of the proportions of vertical oblique and no ground line responses to Stimuli 12 and 17.*

than does ~~S~~stimulus 12, the straight line. In the same way stimulus 12 elicits more orthographic and perspective responses in the same subjects than does stimulus 17. Thus the inclusion of two lines at right angles to the top, and hence an essentially square shape to the stimulus, encourages subjects to draw a square table top, and also discourages subjects from using a ground line or ground plane. This effect is evident in subjects between nine and fifteen years of age. It is interesting to speculate that some of the subjects in this age group, who spontaneously produce 'plan' type of tables as identified in Chapters 3 to 6, do so because of the way in which they place the first lines on the paper.

Whilst there are significant differences in response to the two stimuli there are also similarities. The differences will be addressed later when further cross-stimulus comparisons are made, however in order to compare the different stimulus groups it is necessary to examine the amalgamated data for Group C. Figure 8:D2 shows that few subjects leave

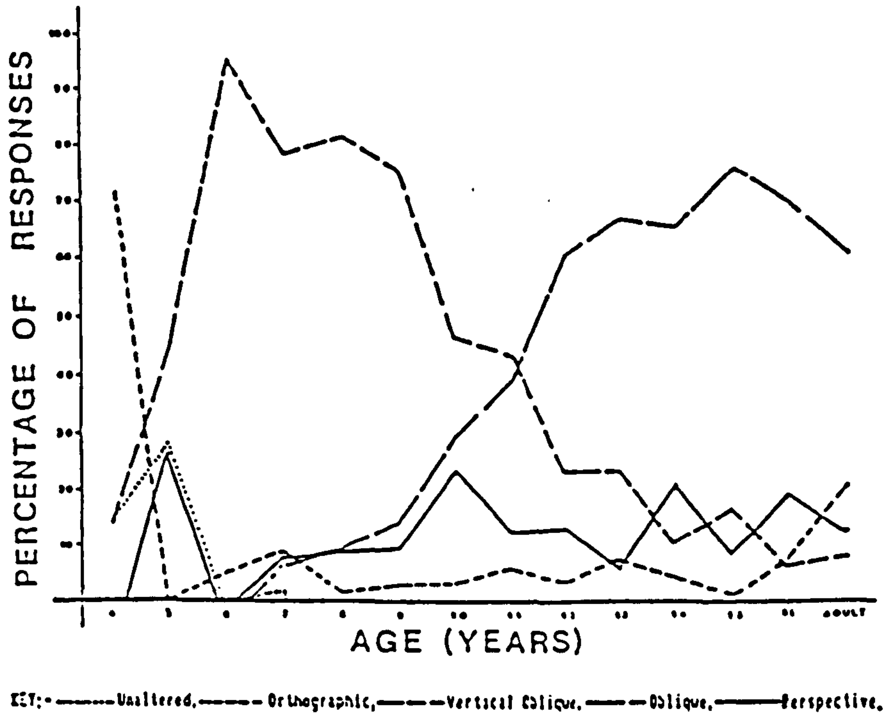


Figure 8;D2. *The proportions of subjects drawing each type of table top, on Stimulus Group C.*

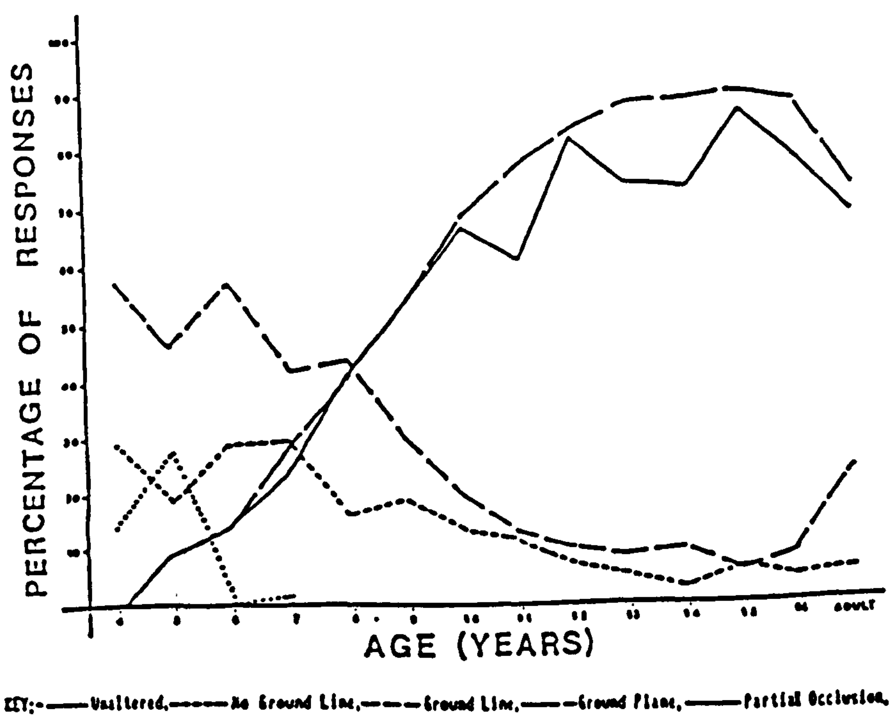


Figure 8;D3. *The proportions of subjects drawing each type of depth cue, on Stimulus Group C.*

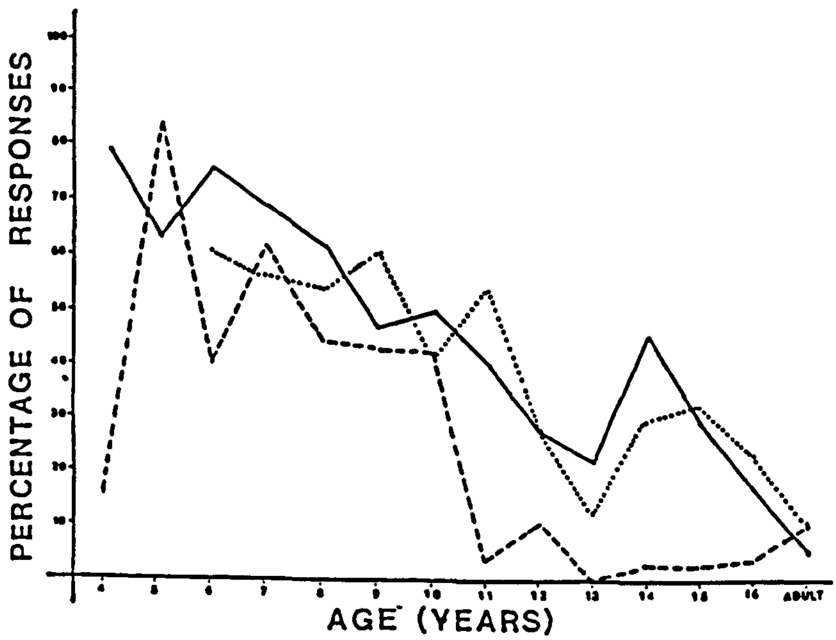
the stimuli unaltered or use orthographic projection. The majority of younger subjects use vertical oblique projection, whilst the majority of older subjects use oblique. A small, but relatively steady proportion of subjects use perspective.

Figure 8:D3 illustrates the way in which depth cues are used in Group C. Subjects show a steadily increasing preference, with age, for the production of ground plane and partial occlusion. Younger subjects prefer no ground line and ground line, and, whilst the strength of this preference declines with age, some subjects, at all ages, complete the stimuli in this way.

2) Detailed analysis of proportions of response, with age, of stimuli in Group D.

This group is comprised of three table types, nos. 23 [ ], 5 [ ], and 8 [ ] in Figure 8:1. The proportions of response, with age, both on type of table top and type of depth cue produced, were compared across the three figures by a series of Kolmogorov Smirnov two sample, one tailed χ^2 approximation tests. These tests found significant differences in the proportions of response, with age, between the three stimuli on some of the perspective, and ground line responses, but failed to find any significant differences in the remaining responses. Comparison of Stimulus no. 23 vs. Stimulus no. 5 = Vertical Oblique:- $K\chi^2 = 0.99$, $df = 2$, $p > 0.05$; Oblique:- $K\chi^2 = 0.65$, $df = 2$, $p > 0.05$; Perspective:- $K\chi^2 = 57.98$, $df = 2$, $p < 0.01$; No ground line:- $K\chi^2 = 4.46$, $df = 2$, $p > 0.05$; Ground line:- $K\chi^2 = 1.33$, $df = 2$, $p > 0.05$; Ground plane:- $K\chi^2 = 0.19$, $df = 2$, $p > 0.05$; Partial Occlusion:- $K\chi^2 = 0.69$, $df = 2$, $p > 0.05$. Comparison of Stimulus no. 23 vs. Stimulus no. 8 = Vertical Oblique:- $K\chi^2 = 0.32$, $df = 2$, $p > 0.05$; Oblique:- $K\chi^2 = 1.23$, $df = 2$, $p > 0.05$; Perspective:- $K\chi^2 = 1.28$, $df = 2$, $p > 0.05$; No ground line:- $K\chi^2 = 0.77$, $df = 2$, $p > 0.05$; Ground line:- $K\chi^2 = 9.15$, $df = 2$, $p < 0.02$; Ground plane:- $K\chi^2 = 1.72$, $df = 2$, $p > 0.05$; Partial Occlusion:- $K\chi^2 = 0.74$, $df = 2$, $p > 0.05$. Comparison of Stimulus no. 8 vs. Stimulus no. 5 = Vertical Oblique:- $K\chi^2 = 3.23$, $df = 2$, $p > 0.05$; Oblique:- $K\chi^2 = 2.43$, $df = 2$, $p > 0.05$; Perspective:- $K\chi^2 = 51.39$, $df = 2$, $p < 0.01$; No ground line:- $K\chi^2 = 1.16$, $df = 2$, $p > 0.05$; Ground line:- $K\chi^2 = 3.88$, $df = 2$, $p > 0.05$; Ground plane:- $K\chi^2 = 1.72$, $df = 2$, $p > 0.05$; Partial Occlusion:- $K\chi^2 = 1.64$, $df = 2$, $p > 0.05$.

Figure 8:D4 shows little significant difference in the perspective response for stimuli 23 and 8, however that elicited by stimulus 5 varies



Key:- ············ Stimulus 23 [ ], ------ Stimulus 5 [ ], ——— Stimulus 8 [ ]

Figure 8:D4. *The proportions, with age, of perspective response for stimuli 23, 5, and 8.*

significantly from both the others. Stimulus 5 encourages a lower proportion of perspective response from older subjects than do the other stimuli. This is counter-balanced by a higher oblique response, however the difference between the stimuli for the oblique response does not reach significance.

Figure 8:D5 illustrates that the majority of younger subjects complete table tops in Group D in perspective, however, with age, an increasing number of subjects complete it in oblique projection. The exception to this is the four year old subjects, the majority of whom alter the stimulus to provide a table top in vertical oblique projection. A small proportion of subjects between five and nine years of age, and a few fifteen year olds, also make this alteration.

Figure 8:D6 shows that the majority of subjects between four and six years old complete the table legs to a ground line, however after this age ground plane and partial occlusion are used.

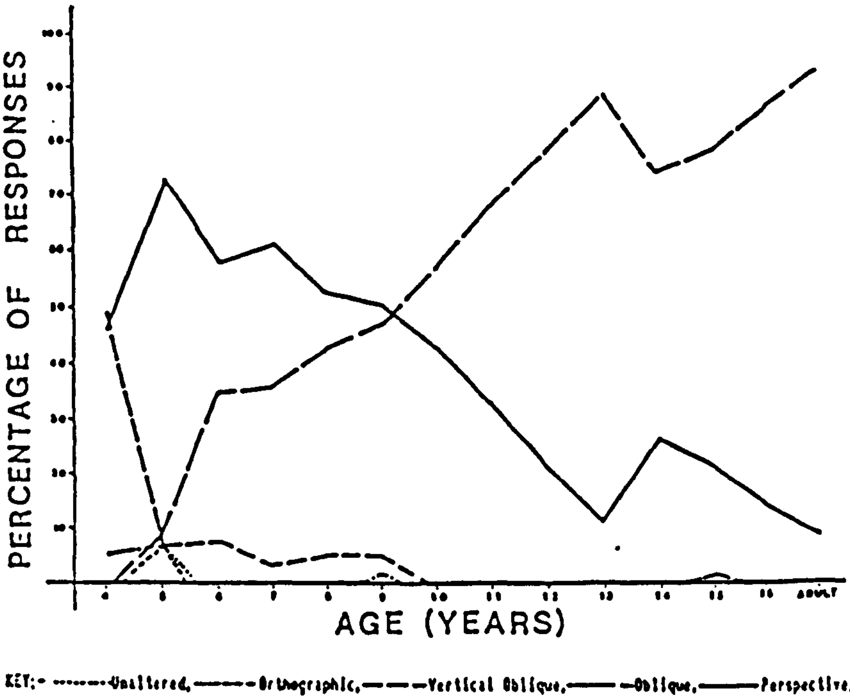


Figure 8;D5. *The proportions of subjects drawing each type of table top, on Stimulus Group D.*

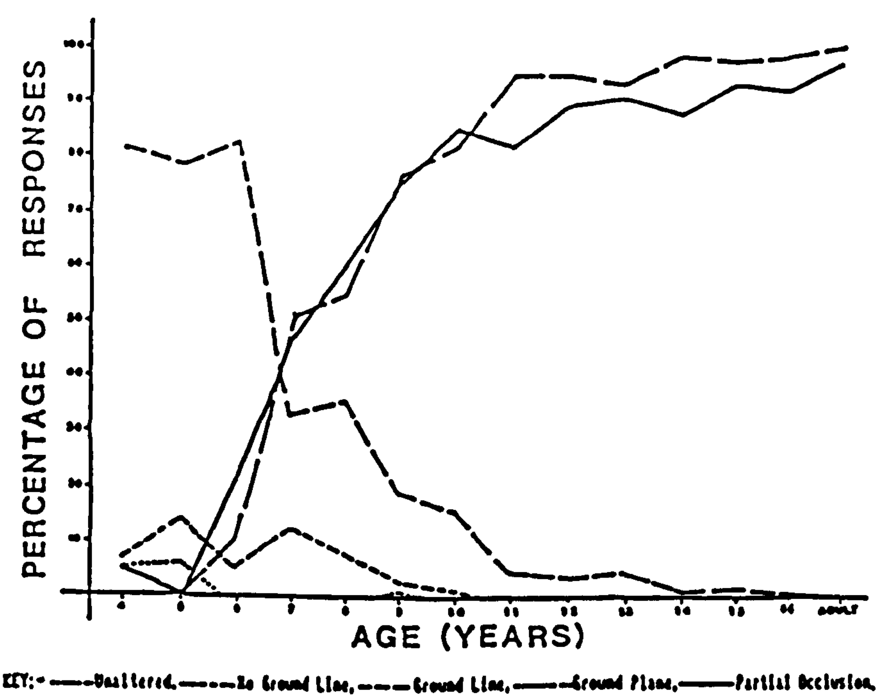
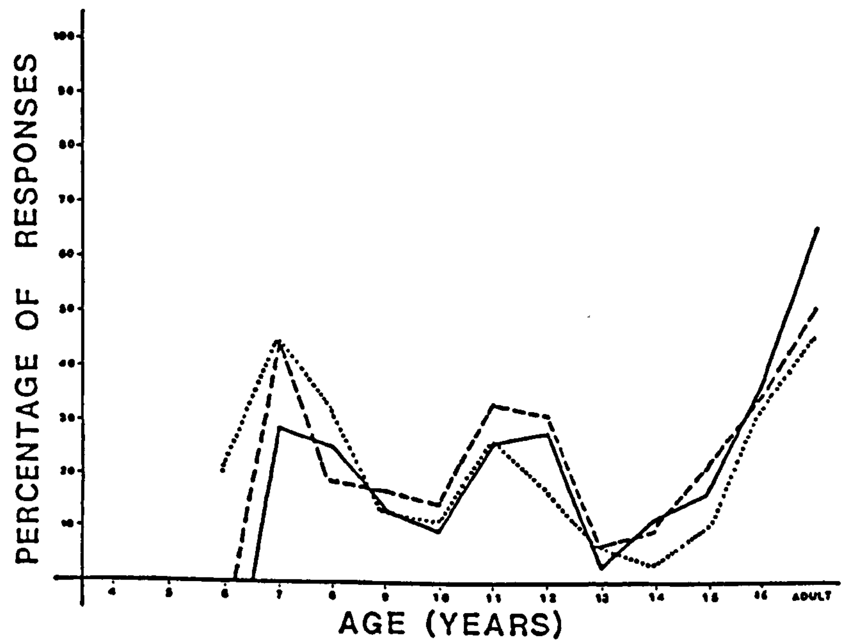


Figure 8;D6. *The proportions of subjects drawing each type of depth cue, on Stimulus Group D.*

3) Detailed analysis of proportions of response, with age, of stimuli in Group E,

This group is comprised of three table types, nos. 2 [ ], 9 [ ], and 14 [ ] in Figure 8:1, forming Group Ea, and a fourth, Stimulus 20 [ ], which together with the others forms Group E. The proportions of response, with age, both on type of table top and type of depth cue produced, were compared across the three figures by a series of Kolmogorov Smirnov two sample, one tailed χ^2 approximation tests. These tests found significant differences in the proportions of response, with age, between the three stimuli in Group Ea on some of the no ground line responses, but failed to find any significant differences in the remaining



Key:- ....Stimulus 2 [ ], ------Stimulus 9 [ ], ——Stimulus 14 [ ].

Figure 8;07. *A comparison of the no ground line response, with age, on Stimuli 2, 9, and 14,*

responses. Comparison of Stimulus no. 2 vs. Stimulus no. 9 = Vertical Oblique:- $K\chi^2 = 0.21$, df = 2, $p > 0.05$; Oblique:- $K\chi^2 = 0.78$, df = 2, $p > 0.05$; Perspective:- $K\chi^2 = 4.48$, df = 2, $p > 0.05$; No ground line:- $K\chi^2 = 6.13$, df = 2, $p < 0.05$; Ground line:- $K\chi^2 = 3.67$, df = 2, $p > 0.05$; Ground plane:- $K\chi^2 = 1.0$, df = 2, $p > 0.05$; Partial Occlusion:- $K\chi^2 = 0.74$, df = 2, $p > 0.05$. Comparison of Stimulus no. 9 vs. Stimulus no. 14 = Vertical Oblique:- $K\chi^2 = 0.21$, df = 2, $p > 0.05$; Oblique:- $K\chi^2 = 1.63$, df = 2, $p > 0.05$; Perspective:- $K\chi^2 = 5.66$, df = 2, $p > 0.05$; No ground line:- $K\chi^2 = 3.39$, df = 2, $p > 0.05$; Ground line:- $K\chi^2 = 2.08$, df = 2, $p > 0.05$; Ground plane:- $K\chi^2 = 0.98$, df = 2, $p > 0.05$; Partial Occlusion:- $K\chi^2 =$

1.25, df = 2, $p > 0.05$. Comparison of Stimulus no. 2 vs. Stimulus no. 14 = Vertical Oblique:- $K\chi^2 = 0.04$, df = 2, $p > 0.05$; Oblique:- $K\chi^2 = 2.77$, df = 2, $p > 0.05$; Perspective:- $K\chi^2 = 5.4$, df = 2, $p > 0.05$; No ground line:- $K\chi^2 = 11.18$, df = 2, $p < 0.01$; Ground line:- $K\chi^2 = 5.75$, df = 2, $p > 0.05$; Ground plane:- $K\chi^2 = 1.01$, df = 2, $p > 0.05$; Partial Occlusion:- $K\chi^2 = 2.07$, df = 2, $p > 0.05$.

These tests indicate that the significant differences between the three stimuli on the no ground line response is attributable to stimulus 2. However, as can be seen in Figure 8:D7, the cause of these differences is unclear.

Stimulus group E also includes Stimulus 20. A statistical comparison of the proportions of response, with age, between Group Ea and Stimulus 20 found significant differences in the perspective response, but failed to find any others. Comparison of Stimulus Group Ea vs. Stimulus no. 20 = Vertical Oblique:- $K\chi^2 = 0.23$, df = 2, $p > 0.05$; Oblique:- $K\chi^2 = 2.61$, df = 2, $p > 0.05$; Perspective:- $K\chi^2 = 7.05$, df = 2, $p < 0.05$; No ground line:- $K\chi^2 = 4.28$, df = 2, $p > 0.05$; Ground line:- $K\chi^2 = 0.67$, df = 2, $p > 0.05$; Ground plane:- $K\chi^2 = 1.81$, df = 2, $p > 0.05$; Partial Occlusion:- $K\chi^2 = 2.04$, df = 2, $p > 0.05$. Very few subjects in any age group produced a perspective response, thus limiting the psychological significance of this finding.

Figure 8:D8 shows that the vast majority of all table tops, at all ages, completed in Group E, are in vertical oblique projection. Some older subjects alter the stimulus to depict the table top in oblique projection, however the number at each age group doing this is very small.

In Figure 8:D9 it can be seen that the way in which the depth cues are drawn on the stimuli in Group E is quite complex. A steadily increasing proportion of younger children, with age, show a preference for using ground plane and partial occlusion, and correspondingly, a steadily decreasing preference for no ground line and ground line. However there is a reversal of these trends between ten and thirteen years of age, until, by adulthood, the majority of subjects use no ground line, with equal numbers of subjects using ground line or ground plane. Decrease in the use of partial occlusion, with age, is even greater than that of ground plane. The no ground line response is further complicated in that it shows a secondary peak between eleven and twelve years of age, reaching approximately 30% at this time. This complex response is elicited by all four stimuli, and indicates an area which might reward further investigation, and which will be discussed later.

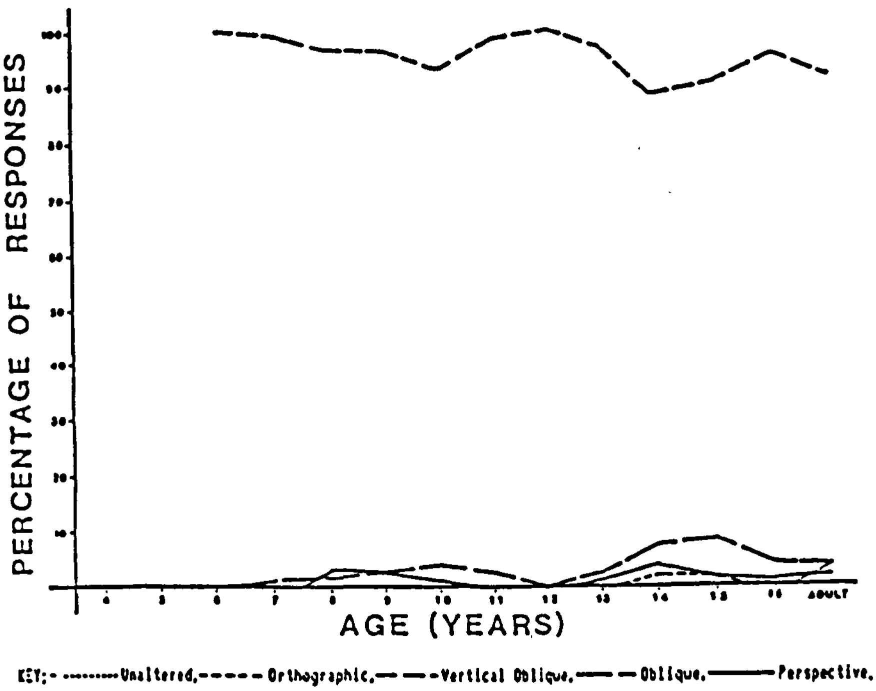


Figure 8:D8. *The proportions of subjects drawing each type of table top, on Stimulus Group E.*

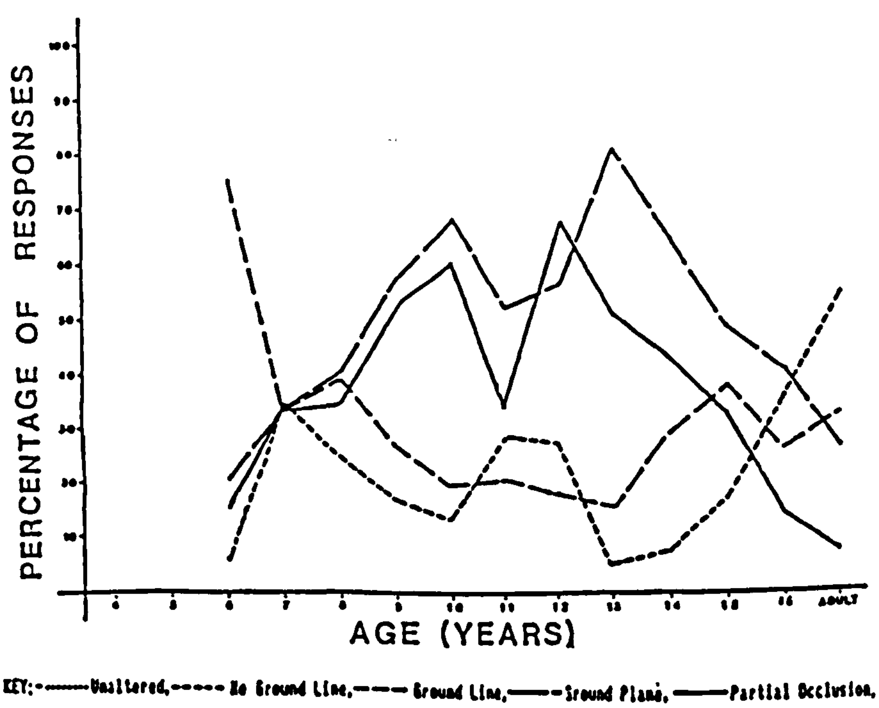
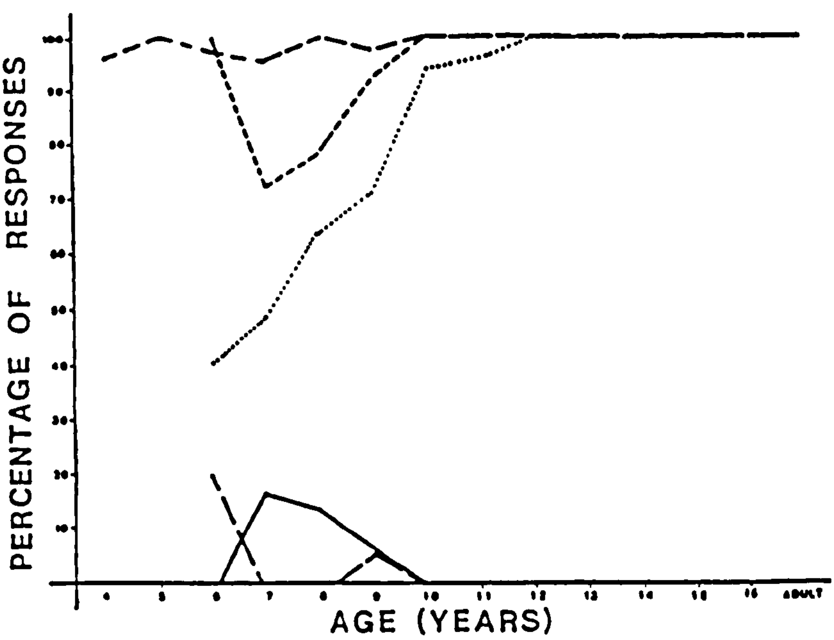


Figure 8:D9. *The proportions of subjects drawing each type of depth cue, on Stimulus Group E.*

4) Detailed analysis of proportions of response, with age, of stimuli in Group F.

This group is comprised of three table types, nos. 7 [ ], 16 [ ], and 22 [ ] in Figure 8:1. The proportions of response, with age, both on type of table top and type of depth cue produced, were compared across the three figures by a series of Kolmogorov Smirnov two sample, one tailed χ^2 approximation tests. These tests found significant differences in the proportions of response, with age, on some of the oblique and perspective responses, but failed to find any significant



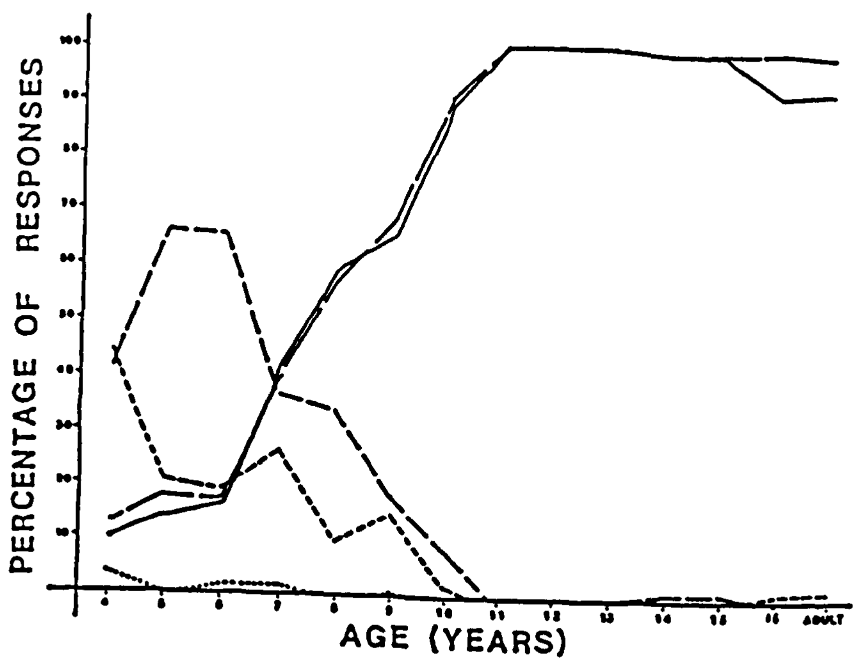
Key:- Stimulus 7 [ ], Stimulus 16 [ ], Stimulus 22 [ ].
OBLIQUE
PERSPECTIVE

Figure 8:D10. *A comparison of the oblique and perspective responses, with age, on Stimuli 7, 16, and 22.*

differences in the remaining responses. Comparison of Stimulus no. 7 vs. Stimulus no. 16 = Vertical Oblique:- $K\chi^2$ = 1.66, df = 2, p > 0.05; Oblique:- $K\chi^2$ = 3.22, df = 2, p > 0.05; Perspective:- $K\chi^2$ = 13.3, df = 2, p < 0.01; No ground line:- $K\chi^2$ = 0.84, df = 2, p > 0.05; Ground line:- $K\chi^2$ = 0.95, df = 2, p > 0.05; Ground plane:- $K\chi^2$ = 0.19, df = 2, p > 0.05; Partial Occlusion:- $K\chi^2$ = 0.19, df = 2, p > 0.05. Comparison of Stimulus no. 7 vs. Stimulus no. 22 = Vertical Oblique:- N.A.; Oblique:- $K\chi^2$ = 13.19, df = 2, p < 0.01; Perspective:- N.A.; No ground line:- $K\chi^2$ = 3.99, df = 2, p > 0.05; Ground line:- $K\chi^2$ = 1.8, df = 2, p > 0.05; Ground plane:- $K\chi^2$ = 0.19, df = 2, p > 0.05; Partial Occlusion:- $K\chi^2$ = 0.19, df = 2, p > 0.05.

KEY: Unaltered, Orthographic, Vertical Oblique, Oblique, Perspective.

Figure 8:D11. *The proportions of subjects drawing each type of table top, on Stimulus Group F.*



KEY: Unaltered, No Ground Line, Ground Line, Ground Plane, Partial Occlusion.

Figure 8:D12. *The proportions of subjects drawing each type of depth cue, on Stimulus Group F.*

Comparison of Stimulus no. 16 vs. Stimulus no. 22 = Vertical Oblique:- N.A.; Oblique:- $K\chi^2$ = 3.42, df = 2, p > 0.05; Perspective:- N.A.; No ground line:- $K\chi^2$ = 0.77, df = 2, p > 0.05; Ground line:- $K\chi^2$ = 0.49, df = 2, p > 0.05; Ground plane:- $K\chi^2$ = 0.19, df = 2, p > 0.05; Partial Occlusion:- $K\chi^2$ = 0.75, df = 2, p > 0.05.

Figure 8:D10 shows that the proportion of subjects responding in oblique projection on the table top is a function of the number of table top lines given in the stimulus. Thus the fewer lines in the stimulus encouraging an oblique response, the less younger subjects make such a response.

Figure 8:D10 also shows the perspective response for the three stimuli. Stimulus 22 elicits no perspective response at all, however a few younger subjects do respond in perspective on stimuli 7 and 16. The fewer the lines to complete in the stimulus, the smaller the proportion of subjects responding with a table top in perspective. Whilst this effect might have statistical significance, the number of subjects responding in this way is very small, and tests failed to find significant differences in the vertical response between the two stimuli, thus indicating that the effect might have little psychological significance.

Figure 8:D11 shows that the majority of all table tops completed in Group F, at all ages, are in oblique projection. However a minority of subjects between 5 and 10 years old appear unhappy with the table top in oblique projection, and alter the stimulus. The majority alter it to form a table top in vertical oblique projection, though between four and ten percent of subjects between six and nine years old alter it to perspective.

In Figure 8:D12 it can be seen that the proportion of subjects using ground plane and partial occlusion rises steadily from about ten percent at four years of age to a hundred percent at eleven. This rise corresponds to a steady decline, with age, in the use of no ground line and ground line, the first being less popular than the second.

5) Detailed analysis of proportions of response, with age, of stimuli in Group G.

This group is comprised of three table types, nos. 15 [ ], 21 [ ], and 3 [ ] in Figure 8:1. The proportions of response, with age, both on type of table top and type of depth cue produced, were compared across the three figures by a series of Kolmogorov Smirnov two sample, one tailed χ^2 approximation tests. These tests found significant differences in the proportions of response, with age, between the three stimuli in Group G on some of the perspective responses, but failed to find any significant differences in the remaining responses. Comparison of Stimulus no. 15 vs. Stimulus no. 21 = Vertical Oblique:- $K\chi^2 = 1.06$, df = 2, $p > 0.05$; Oblique:- $K\chi^2 = 2.28$, df = 2, $p > 0.05$; Perspective:- $K\chi^2 = 5.19$, df = 2, $p > 0.05$; No ground line:- $K\chi^2 = 0.83$, df = 2, $p > 0.05$; Ground line:- $K\chi^2 = 1.58$, df = 2, $p > 0.05$; Ground plane:- $K\chi^2 = 0.75$, df = 2, $p > 0.05$; Partial Occlusion:- $K\chi^2 = 0.74$, df = 2, $p > 0.05$. Comparison of Stimulus no. 15 vs. Stimulus no. 3 = Vertical Oblique:- $K\chi^2 = 2.08$, df = 2, $p > 0.05$; Oblique:- $K\chi^2 = 1.74$, df = 2, $p > 0.05$; Perspective:- $K\chi^2 = 9.94$, df = 2, $p < 0.01$; No ground line:- $K\chi^2 = 1.57$, df = 2, $p > 0.05$; Ground line:- $K\chi^2 = 2.26$, df = 2, $p > 0.05$; Ground plane:- $K\chi^2 = 1.67$, df = 2, $p > 0.05$; Partial Occlusion:- $K\chi^2 = 1.66$, df = 2, $p > 0.05$. Comparison of Stimulus no. 21 vs. Stimulus no. 3 = Vertical Oblique:- $K\chi^2 = 3.07$, df = 2, $p > 0.05$; Oblique:- $K\chi^2 = 2.1$, df = 2, $p > 0.05$; Perspective:- $K\chi^2 = 1.89$, df = 2, $p > 0.05$; No ground line:- $K\chi^2 = 2.56$, df = 2, $p > 0.05$; Ground line:- $K\chi^2 = 2.64$, df = 2, $p > 0.05$; Ground plane:- $K\chi^2 = 0.73$, df = 2, $p > 0.05$; Partial Occlusion:- $K\chi^2 = 0.73$, df = 2, $p > 0.05$.

Key:- .... Stimulus 15 [ ], ------ Stimulus 21 [ ], ——— Stimulus 3 [ ].

Figure 8:D13. *A comparison of the perspective response, with age, on Stimuli 15, 21, and 3.*

Figure 8:D13 shows that the proportion of subjects responding in perspective on the table top is a function of the number of table top

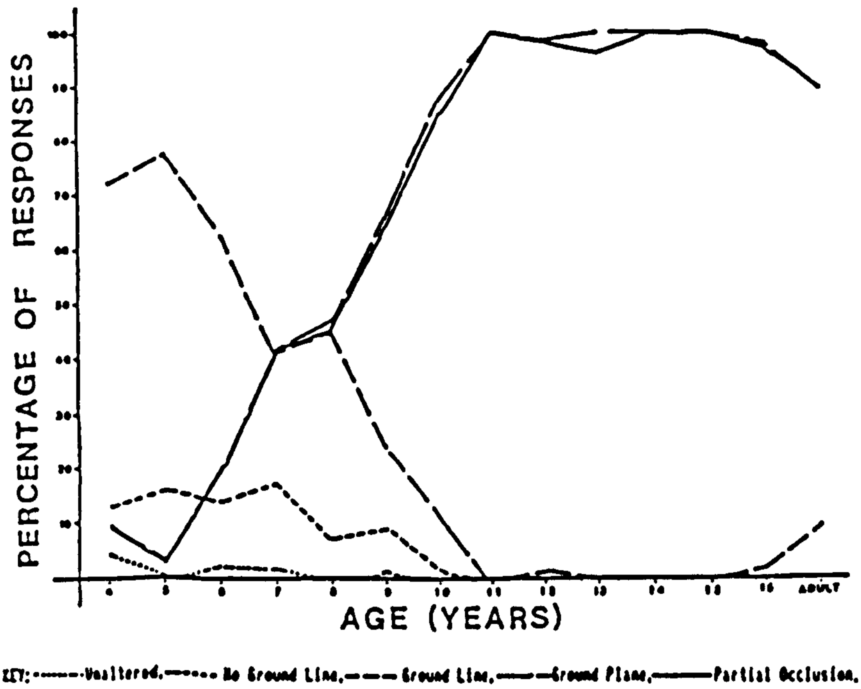


Figure 8:D14. *The proportions of subjects drawing each type of table top, on Stimulus Group 6.*

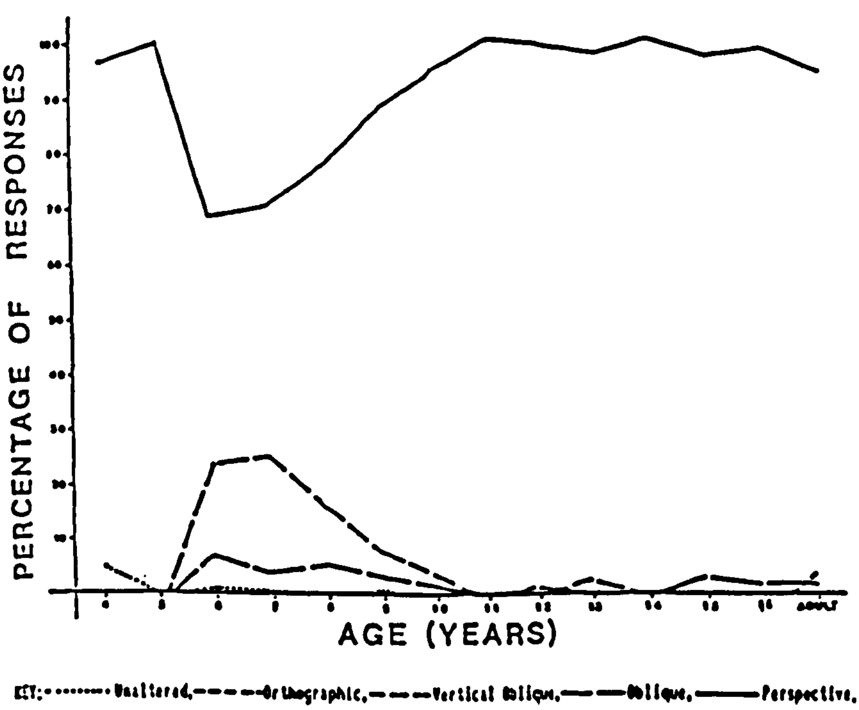


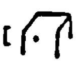
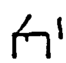
Figure 8:D15. *The proportions of subjects drawing each type of depth cue, on Stimulus Group 6.*

lines given in the stimulus. Thus the fewer lines in the stimulus encouraging a perspective response, the less younger subjects make such a response.

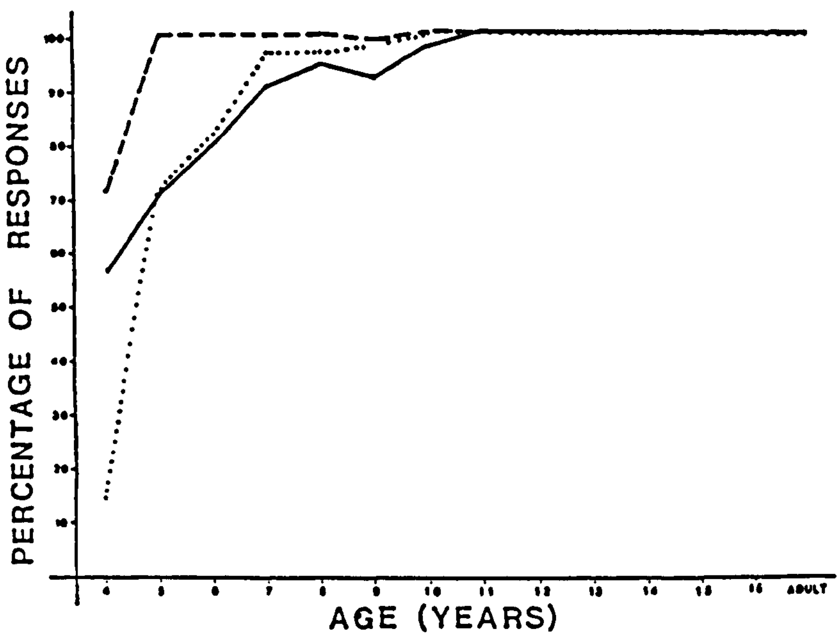
Figure 8:D14 shows that the majority of all table tops completed in Group G, at all ages, are in perspective. However a minority of subjects between 5 and 10 years old appear unhappy with the table top in perspective, and alter the stimulus. The majority alter it to form a table top in vertical oblique projection, though between two and five percent of subjects between six and nine years old alter it to oblique projection.

In Figure 8:D15 it can be seen that the proportion of subjects using ground plane and partial occlusion rises steadily from about four percent at five years of age to a hundred percent at eleven. This rise corresponds to a steady decline, with age, in the use of ground line. No ground line is used by between eight and fifteen percent of subjects between four and nine years of age.

6) Detailed analysis of proportions of response, with age, of stimuli in Group H.

This group is comprised of three table types, nos. 19 [], 10 [], and 18 [] in Figure 8:1, forming Group Ha, and a fourth, stimulus 4 [], which together with the others forms Group H. The proportions of response, with age, both on type of table top and type of depth cue produced, were compared across the three figures by a series of Kolmogorov Smirnov two sample, one tailed χ^2 approximation tests. These tests found significant differences in the proportions of response, with age, between the three stimuli in Group Ha on some of the oblique responses, but failed to find any significant differences in the remaining responses. Comparison of Stimulus no. 19 vs. Stimulus no. 10 = Vertical Oblique:-N.A.; Oblique:- $K\chi^2 = 12.86$, df = 2, $p < 0.01$; Perspective:- N.A.; No ground line:- N.A.; Ground line:- $K\chi^2 = 0.86$, df = 2, $p > 0.05$; Ground plane:- $K\chi^2 = 0.86$, df = 2, $p > 0.05$; Partial Occlusion:- $K\chi^2 = 0.22$, df = 2, $p > 0.05$. Comparison of Stimulus no. 19 vs. Stimulus no. 18 = Vertical Oblique:- $K\chi^2 = 1.92$, df = 2, $p > 0.05$; Oblique:- $K\chi^2 = 2.29$, df = 2, $p > 0.05$; Perspective:- N.A.; No ground line:- N.A.; Ground line:- $K\chi^2 = 2.13$, df = 2, $p > 0.05$; Ground plane:- $K\chi^2 = 0.21$, df = 2, $p > 0.05$; Partial Occlusion:- $K\chi^2 = 0.22$, df = 2, $p > 0.05$. Comparison of Stimulus no. 10 vs. Stimulus no. 18 = Vertical Oblique:- N.A.; Oblique:- $K\chi^2 = 0.22$, df = 2, $p > 0.05$; Perspective:- N.A.; No ground line:- N.A.; Ground line:- $K\chi^2 = 0.48$, df = 2, $p > 0.05$; Ground plane:- $K\chi^2 = 0.22$, df = 2, $p > 0.05$;

Partial Occlusion:- $K\chi^2 = 0.00$, df = 2, $p > 0.05$.



Key:- ....Stimulus 19 [ ], ------Stimulus 10 [ ], ——— Stimulus 18 [ ].

Figure 8:D16. *A comparison of the oblique response, with age, on Stimuli 19, 10, and 18.*

Figure 8:D16 indicates that the significant difference on the oblique response between stimuli 19 and 10 is because a greater proportion of the younger subjects are able to complete the stimulus correctly when it is the top back line that is missing.

Stimulus group H also includes Stimulus 4. A statistical comparison of the proportions of response, with age, between Group Ha and Stimulus 4 failed to find any significant differences. Comparison of Stimulus Group Ha vs. Stimulus no. 4 = Vertical Oblique:- $K\chi^2 = 0.72$, df = 2, $p > 0.05$; Oblique:- $K\chi^2 = 1.91$, df = 2, $p > 0.05$; Perspective:- $K\chi^2 = 0.72$, df = 2, $p > 0.05$; No ground line:- N.A.; Ground line:- $K\chi^2 = 0.69$, df = 2, $p > 0.05$; Ground plane:- $K\chi^2 = 0.85$, df = 2, $p > 0.05$; Partial Occlusion:- $K\chi^2 = 0.22$, df = 2, $p > 0.05$.

Figure 8:D17 shows that the vast majority of all table tops, at all ages, are in oblique projection. However between five and ten percent of subjects between the ages of four and nine alter the stimulus to depict the table top in vertical oblique projection, rather than adding the single line required to complete the stimulus. A smaller proportion of subjects (3 to 5%) aged between seven and nine, alter the stimulus to give a table top in perspective.

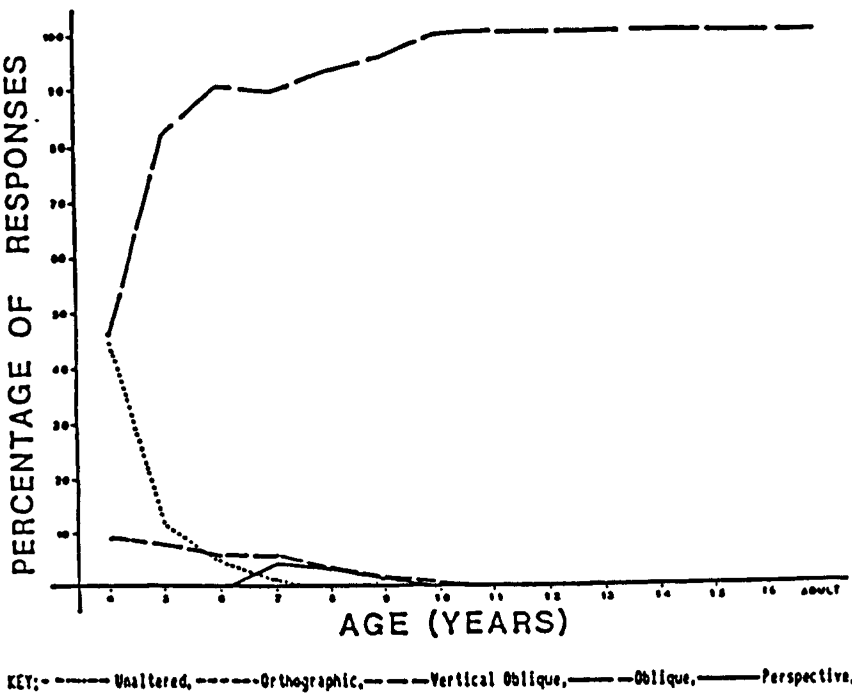


Figure 8:D17. *The proportions of subjects drawing each type of table top, on Stimulus Group H.*

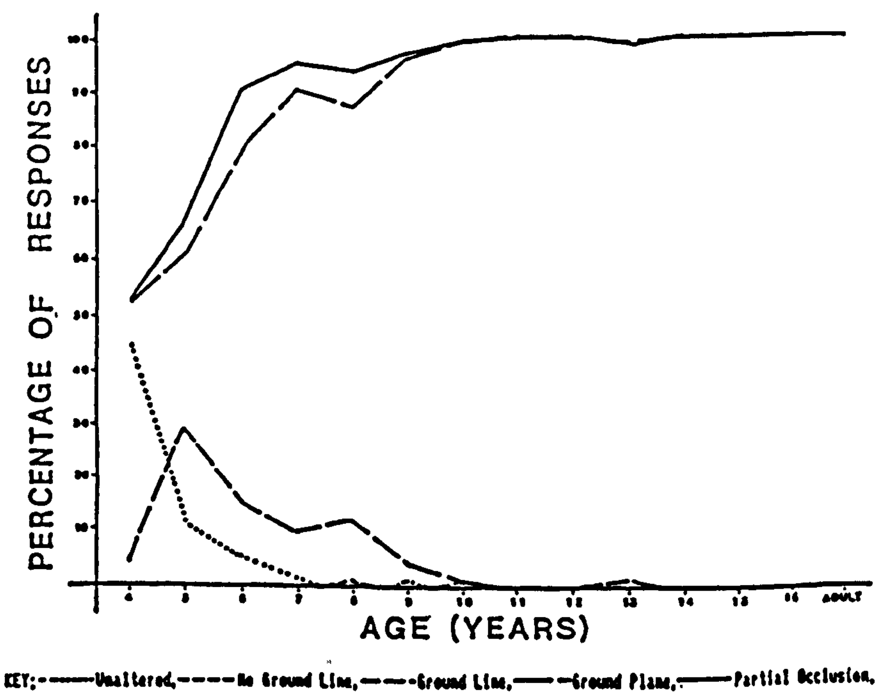


Figure 8:D18. *The proportions of subjects drawing each type of depth cue, on Stimulus Group H.*

The stimuli for completion in Group H use the depth cues of ground plane and partial occlusion. In Figure 8:D18 it can be seen that between four and thirty percent of subjects from four to nine years of age deliberately alter the stimuli, by extending the legs, to give a ground line rather than accept the use of ground plane.

7) Detailed analysis of proportions of response, with age, of stimuli in Group I.

This group is comprised of three table types, nos. 1 [], 13 [], and 24 [] in Figure 8:1, forming Group Ia, and a fourth, Stimulus 11 [], which together with the others forms Group I. The proportions of response, with age, both on type of table top and type of depth cue produced, were compared across the three figures by a series of Kolmogorov Smirnov two sample, one tailed χ^2 approximation tests. These tests found significant differences in the proportions of response, with age, between the three stimuli in Group Ia on some of the no ground line responses, but failed to find any significant differences in the remaining responses. Comparison of Stimulus no. 1 vs. Stimulus no. 13 = Vertical Oblique:- $K\chi^2 = 1.92$, df = 2, $p > 0.05$; Oblique:- N.A.; Perspective:- $K\chi^2 = 1.84$, df = 2, $p > 0.05$; No ground line:- $K\chi^2 = 10.7$, df = 2, $p < 0.01$; Ground line:- $K\chi^2 = 2.38$, df = 2, $p > 0.05$; Ground plane:- $K\chi^2 = 0.83$, df = 2, $p > 0.05$; Partial Occlusion:- $K\chi^2 = 0.83$, df = 2, $p > 0.05$. Comparison of Stimulus no. 1 vs. Stimulus no. 24 = Vertical Oblique:- $K\chi^2 = 5.08$, df = 2, $p > 0.05$; Oblique:- N.A.; Perspective:- $K\chi^2 = 1.83$, df = 2, $p > 0.05$; No ground line:- $K\chi^2 = 7.17$, df = 2, $p < 0.05$; Ground line:- $K\chi^2 = 1.0$, df = 2, $p > 0.05$; Ground plane:- $K\chi^2 = 0.21$, df = 2, $p > 0.05$; Partial Occlusion:- $K\chi^2 = 0.82$, df = 2, $p > 0.05$. Comparison of Stimulus no. 13 vs. Stimulus no. 24 = Vertical Oblique:- $K\chi^2 = 3.85$, df = 2, $p > 0.05$; Oblique:- N.A.; Perspective:- $K\chi^2 = 0.22$, df = 2, $p > 0.05$; No ground line:- $K\chi^2 = 4.02$, df = 2, $p > 0.05$; Ground line:- $K\chi^2 = 1.61$, df = 2, $p > 0.05$; Ground plane:- $K\chi^2 = 1.86$, df = 2, $p > 0.05$; Partial Occlusion:- $K\chi^2 = 1.86$, df = 2, $p > 0.05$.

Whilst the tests do find significant differences in the no ground line response, they are attributable to the way in which 0.003% of the subjects completed Stimulus 1. This limits the psychological significance of the finding.

Stimulus group I also includes Stimulus 11. A statistical comparison of the proportions of response, with age, between Group Ia and Stimulus 11 failed to find any significant differences. Comparison of

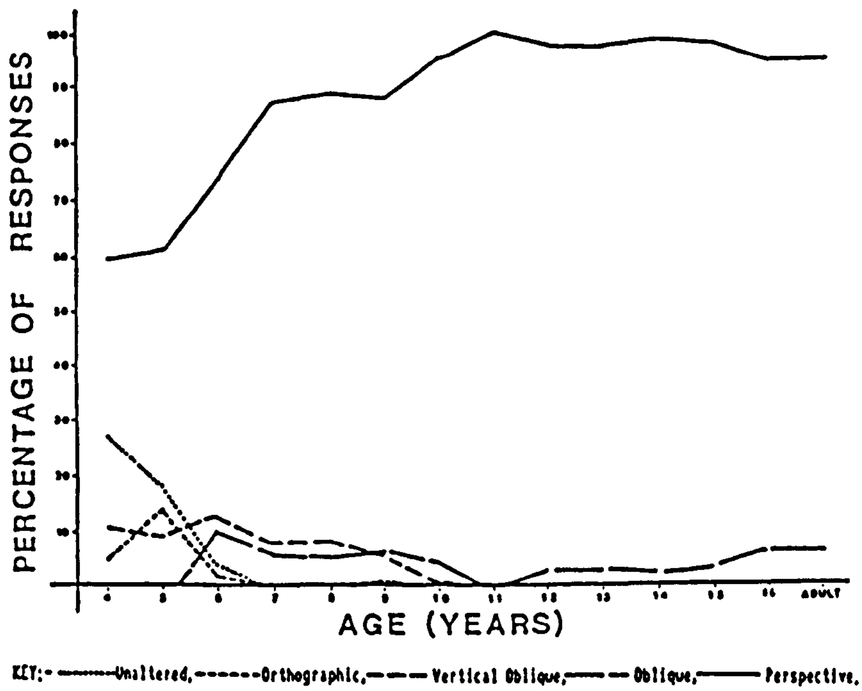


Figure 8:D19. *The proportions of subjects drawing each type of table top, on Stimulus Group I.*

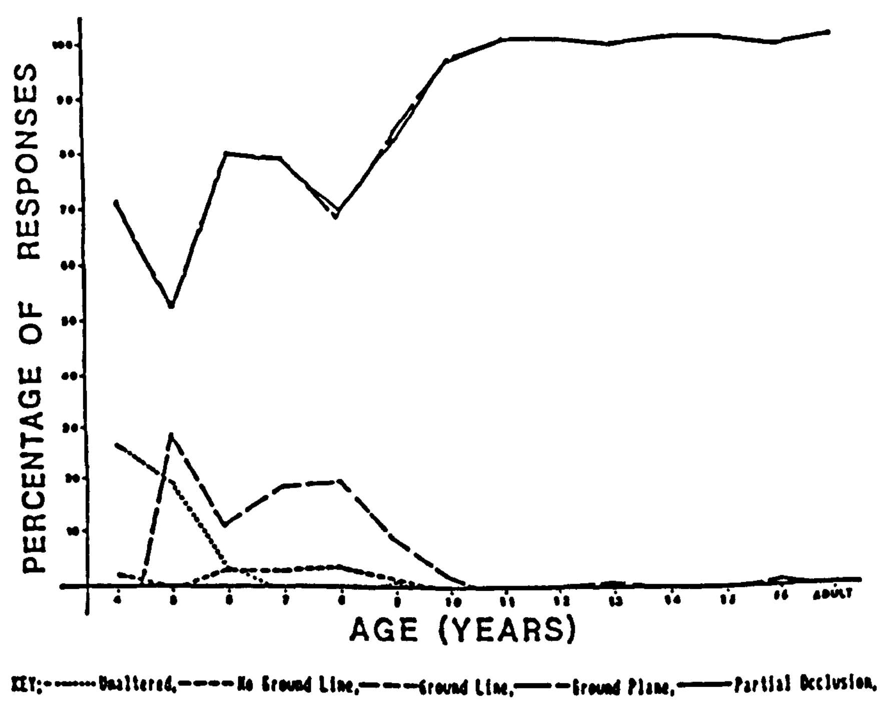


Figure 8:D20. *The proportions of subjects drawing each type of depth cue, on Stimulus Group I.*

Stimulus Group Ia vs. Stimulus no. 11 = Vertical Oblique:- $K\chi^2 = 2.43$, $df = 2$, $p > 0.05$; Oblique:- $K\chi^2 = 3.91$, $df = 2$, $p > 0.05$; Perspective:- $K\chi^2 = 4.24$, $df = 2$, $p > 0.05$; No ground line:- $K\chi^2 = 0.28$, $df = 2$, $p > 0.05$; Ground line:- $K\chi^2 = 0.05$, $df = 2$, $p > 0.05$; Ground plane:- $K\chi^2 = 0.2$, $df = 2$, $p > 0.05$; Partial Occlusion:- $K\chi^2 = 0.21$, $df = 2$, $p > 0.05$.

Figure 8:D19 shows that the majority of all table tops, at all ages, are completed in perspective for stimuli in Group I. There are two main exceptions to this. Until subjects are ten years old a small proportion of them in each age group alter the stimulus to produce a table top in vertical oblique projection. Secondly, from about six years of age, a small, but steady proportion of subjects in each age group alter the stimulus to give a table top in oblique projection.

The stimuli for completion in Group H use the depth cues of ground plane and partial occlusion. In Figure 8:D18 it can be seen that approximately twenty percent of subjects from five to nine years of age deliberately alter the stimuli, by extending the legs, to give a ground line rather than accept the use of ground plane.

Appendix 8: E.

Data amalgamated across each stimulus group, giving proportions of response, with age for each group.

This appendix presents the data discussed in Chapter 8 amalgamated across stimulus groups. It contains two parts. The use of projection system on the table top, with age, for each stimulus group is given in the first part. In the second part the use of depth cues, with age, for each stimulus group is given.

Appendix 8:Ea. Use of projection system, by stimulus group.

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Analysis of table top depiction in the Stimulus Groups.

Key:- 0 = Stimulus unaltered, 1 = Orthographic, 2 = Vertical Oblique, 3 = Oblique, 4 = Perspective.

Analysis of table tops, GROUP C.

Table Top	Age in Years. 4	5	6	7	8	9	10	11	12	13	14	15	16	>20.
0	14,2	27,2	0,0	1,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
1	71,4	0,0	4,5	8,3	1,4	2,2	2,5	5,4	3,3	6,3	4,4	1,3	7,1	20,0
2	14,2	45,4	95,5	77,9	81,3	75,7	45,9	42,9	23,3	23,4	10,3	15,8	5,7	7,5
3	0,0	0,0	0,0	5,1	9,1	13,2	28,6	39,3	60,0	65,6	64,7	75,0	68,6	60,0
4	0,0	26,2	0,0	7,1	8,1	8,8	23,0	12,5	13,3	4,7	20,6	7,9	18,6	12,5

Analysis of table tops, GROUP D.

Table Top	Age in Years. 4	5	6	7	8	9	10	11	12	13	14	15	16	>20.
0	5,6	6,3	0,0	0,0	0,0	0,7	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
1	0,0	6,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2	48,5	6,3	7,7	3,3	4,9	4,5	0,0	0,0	0,0	0,0	0,0	0,9	0,0	0,0
3	0,0	8,4	34,5	35,3	42,1	45,3	56,8	67,9	78,9	88,5	74,5	78,1	85,7	91,7
4	46,1	72,9	57,8	61,4	53,0	49,5	43,2	32,1	21,1	11,5	25,5	21,1	14,3	8,3

Ap.8:Ea. Continued.

Analysis of table tops, GROUP Eα

Table Ion	Age in Years. 4	5	6	7	8	9	10	11	12	13	14	15	16	≥20
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	100.0	98.7	97.6	96.5	94.3	98.8	100.0	96.9	90.2	91.2	95.2	93.3
3	0.0	0.0	0.0	1.3	1.2	1.8	4.8	1.2	0.0	2.1	5.9	7.9	3.8	5.0
4	0.0	0.0	0.0	0.0	1.2	1.8	1.0	0.0	0.0	1.0	3.9	0.9	1.0	1.7

Analysis of table tops, GROUP E

Table Ion	Age in Years. 4	5	6	7	8	9	10	11	12	13	14	15	16	≥20
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.7	0.0	3.8
2	0.0	0.0	100.0	99.0	96.4	96.1	95.7	98.2	100.0	96.9	88.2	90.1	95.0	91.3
3	0.0	0.0	0.0	1.0	0.9	2.0	3.6	1.8	0.0	2.3	7.4	8.6	4.3	3.8
4	0.0	0.0	0.0	0.0	2.7	2.0	0.7	0.0	0.0	0.8	3.7	0.7	0.7	1.3

Analysis of table tops, GROUP F.

Table Ion	Age in Years. 4	5	6	7	8	9	10	11	12	13	14	15	16	≥20
0	3.3	0.0	1.0	1.2	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	13.3	21.3	14.3	8.8	1.9	1.2	0.0	0.0	0.0	0.0	0.0	0.0
3	96.6	100.0	79.0	72.1	81.0	87.2	98.1	98.8	100.0	100.0	100.0	100.0	100.0	100.0
4	0.0	0.0	6.7	5.3	4.8	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Ap.8:Ea. Continued.

Analysis of table tops, GROUP 6.

Table Top	Age in Years, 4	5	6	7	8	9	10	11	12	13	14	15	16	>20.
0	3.3	0.0	1.0	0.6	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.7
2	0.0	0.0	24.3	25.3	16.6	7.6	3.7	0.0	0.0	3.0	0.0	0.0	0.0	0.0
3	0.0	0.0	6.7	4.0	4.8	3.5	1.5	0.0	1.1	0.0	0.0	2.6	1.9	1.7
4	96.6	100.0	68.1	70.1	78.6	88.4	94.8	100.0	98.9	97.0	100.0	97.4	98.1	94.6

Analysis of table tops, GROUP Ha.

Table Top	Age in Years, 4	5	6	7	8	9	10	11	12	13	14	15	16	>20.
0	44.3	11.5	6.1	1.0	0.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	8.3	7.1	6.7	3.2	2.4	1.9	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	47.3	81.4	87.3	95.8	97.6	96.0	99.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0
4	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Analysis of table tops, GROUP H

Table Top	Age in Years, 4	5	6	7	8	9	10	11	12	13	14	15	16	>20.
0	44.3	11.5	4.6	0.8	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	8.3	7.1	5.0	5.4	3.6	2.1	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	47.3	81.4	90.5	89.9	92.9	95.0	99.6	100.0	100.0	100.0	100.0	100.0	100.0	100.0
4	0.0	0.0	0.0	4.0	3.6	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Ap.8:Ea. Continued.

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Analysis of table tops, GROUP Ia

Table Top	Age in Years, 4	5	6	7	8	9	10	11	12	13	14	15	16	>20.
0	25,9	17,5	4,8	0,0	0,0	0,7	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
1	4,8	13,3	2,4	0,0	0,0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2	10,4	8,8	9,3	6,2	6,7	4,5	0,7	0,0	0,0	0,0	0,0	0,0	0,0	0,0
3	0,0	0,0	5,6	3,3	3,0	4,4	4,2	0,0	2,2	3,1	1,0	1,8	4,8	5,0
4	58,9	60,4	78,0	90,5	90,3	89,7	95,1	100,0	97,8	96,9	99,0	98,2	95,2	95,0

Analysis of table tops, GROUP I

Table Top	Age in Years, 4	5	6	7	8	9	10	11	12	13	14	15	16	>20.
0	25,9	17,5	3,6	0,0	0,0	0,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
1	4,8	13,3	1,8	0,0	0,0	0,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2	10,4	8,8	12,0	7,7	7,7	5,4	0,5	0,0	0,0	0,8	0,0	0,0	0,0	0,0
3	0,0	0,0	9,2	5,5	4,0	5,9	3,9	0,0	2,5	2,3	0,8	2,0	5,0	5,0
4	58,9	60,4	73,5	86,9	88,3	87,7	95,6	100,0	97,5	96,9	99,3	98,0	95,0	95,0

Appendix 8.Eb. Use of depth cue, by stimulus group.

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Analysis of Depth Cue depiction in the Stimulus Groups.

Key:- A = Stimulus unaltered, B = No Ground line, C = Ground line, D = Ground Plane, E = Partial Occlusion,

Analysis of Depth Cues, GROUP C,

	Age in Years,													
Depth Cues	4	5	6	7	8	9	10	11	12	13	14	15	16	>20.
A	14,4	27,3	0,0	1,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
B	28,6	18,2	28,2	28,5	16,3	17,9	12,9	10,9	6,7	4,7	3,0	5,3	4,4	5,0
C	57,1	45,5	57,3	41,5	43,3	28,9	18,8	12,5	10,0	7,8	8,9	5,3	8,6	22,3
D	0,0	9,1	14,6	28,5	40,5	53,2	68,4	76,8	83,4	87,5	88,2	89,5	87,2	72,5
E	0,0	9,1	14,6	25,4	40,9	53,2	67,0	60,8	81,5	73,5	72,1	85,6	77,2	67,5

Analysis of Depth Cues, GROUP D,

	Age in Years,													
Depth Cues	4	5	6	7	8	9	10	11	12	13	14	15	16	>20.
A	5,6	6,3	0,0	0,0	0,0	0,7	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
B	7,2	14,6	5,3	12,6	8,2	3,1	1,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0
C	81,8	79,2	83,6	33,5	36,0	19,4	16,6	4,8	4,4	5,2	1,0	1,7	1,0	0,0
D	5,6	0,0	11,1	51,8	55,6	76,8	82,5	95,7	95,6	94,8	99,0	98,3	99,0	100,0
E	5,6	0,0	23,3	47,7	58,1	76,0	84,9	82,2	90,0	90,6	88,2	93,8	92,4	96,7

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Analysis of Depth Cues, GROUP Eα

Age in Years.

Depth Cues	4	5	6	7	8	9	10	11	12	13	14	15	16	>20.
A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B	0.0	0.0	6.7	37.3	25.0	14.0	11.5	27.4	24.5	5.2	7.8	15.8	35.0	53.3
C	0.0	0.0	73.3	32.0	36.9	26.3	22.9	20.3	16.7	14.6	28.4	36.8	24.7	28.3
D	0.0	0.0	20.0	30.7	38.1	59.6	65.7	52.4	58.9	80.2	63.7	47.4	41.0	18.3
E	0.0	0.0	20.0	30.7	34.5	54.4	59.1	33.3	45.6	51.0	43.3	31.5	14.3	8.3

Analysis of Depth Cues, GROUP E

Age in Years.

Depth Cues	4	5	6	7	8	9	10	11	12	13	14	15	16	>20.
A	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
B	0,0	0,0	5,0	34,0	24,1	15,8	12,9	27,9	26,7	4,7	7,4	16,5	35,5	53,8
C	0,0	0,0	75,0	33,0	37,5	26,3	19,3	20,6	17,5	14,8	28,0	36,8	25,8	31,3
D	0,0	0,0	20,0	33,0	38,4	57,9	67,9	51,8	55,9	80,5	64,7	46,7	39,3	16,5
E	0,0	0,0	15,0	33,0	34,8	52,0	60,0	33,0	68,3	50,8	42,5	32,2	13,6	7,5

Analysis of Depth Cues, GROUP F.

Age in Years.

Depth Cues	4	5	6	7	8	9	10	11	12	13	14	15	16	>20.
A	3,3	0,0	1,0	1,2	0,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
B	43,4	20,0	18,1	25,3	9,4	14,6	2,0	0,0	0,0	0,0	0,0	0,0	1,0	1,7
C	40,0	63,3	65,7	34,8	33,7	17,1	7,8	0,0	0,0	0,0	1,0	0,9	0,0	0,0
D	13,3	16,7	15,2	38,7	56,4	67,9	90,2	100,0	100,0	100,0	99,0	99,1	99,0	98,3
E	9,9	13,5	14,3	39,0	59,0	65,3	89,0	100,0	100,0	100,0	99,0	99,1	90,5	91,7

Ap.8.Eb. Continued.

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Analysis of Depth Cues, GROUP G.

Depth Cues	Age in Years, 4	5	6	7	8	9	10	11	12	13	14	15	16	>20.
A	3,3	0,0	2,9	1,8	0,0	1,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
B	13,3	16,3	14,3	17,3	7,6	8,5	1,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0
C	73,3	78,0	64,3	40,8	44,8	24,1	11,3	0,0	1,1	0,0	0,0	0,0	1,9	8,7
D	10,0	3,3	20,5	41,3	47,6	66,4	87,3	100,0	98,9	100,0	100,0	100,0	98,1	89,6
E	10,0	3,3	20,5	41,3	45,2	64,6	86,8	100,0	98,9	96,0	100,0	100,0	97,1	89,6

Analysis of Depth Cues, GROUP Ha

Depth Cues	Age in Years, 4	5	6	7	8	9	10	11	12	13	14	15	16	>20.
A	44,4	11,5	6,1	1,0	1,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
B	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
C	4,2	28,3	13,1	6,6	10,4	3,7	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0
D	51,5	60,2	80,8	92,4	89,6	98,0	99,4	100,0	100,0	100,0	100,0	100,0	100,0	100,0
E	51,5	66,9	86,8	96,1	97,4	97,2	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0

Analysis of Depth Cues, GROUP H

Depth Cues	Age in Years, 4	5	6	7	8	9	10	11	12	13	14	15	16	>20.
A	44,4	11,5	4,6	0,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
B	0,0	0,0	0,0	0,0	0,9	0,0	0,7	0,0	0,0	0,0	0,0	0,0	0,0	0,0
C	4,2	28,3	14.8	9,0	6,4	3,1	0,5	0,0	0,0	0,8	0,0	0,0	0,0	0,0
D	51,5	60,2	80,6	90,3	87,7	95,9	98,8	100,0	100,0	99,2	100,0	100,0	100,0	100,0
E	51,5	66,9	90,2	95,1	94,5	96,6	98,8	100,0	100,0	99,2	100,0	100,0	100,0	100,0

Ap.8.Eb. Continued.

Analysis of Depth Cues, GROUP Ia

Depth Cues	Age in Years: 4	5	6	7	8	9	10	11	12	13	14	15	16	≥20
A	25.9	17.5	4.8	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B	2.1	0.0	4.2	2.7	2.9	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
C	0.0	31.2	13.1	17.8	27.5	8.2	3.1	0.0	0.0	0.0	0.0	0.0	1.0	0.0
D	72.0	51.4	75.9	79.5	69.6	84.4	96.9	100.0	100.0	99.0	100.0	100.0	99.0	100.0
E	72.0	51.4	75.9	80.3	70.4	83.8	96.9	100.0	100.0	99.0	100.0	100.0	99.0	100.0

Analysis of Depth Cues, GROUP I

Depth Cues	Age in Years: 4	5	6	7	8	9	10	11	12	13	14	15	16	≥20
A	26.6	18.1	3.6	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B	1.6	0.0	3.2	2.8	3.7	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C	0.0	28.4	11.6	18.2	18.7	8.9	3.5	0.0	0.0	0.8	0.0	0.0	0.7	0.0
D	71.9	53.5	80.0	79.0	67.7	85.1	96.5	100.0	100.0	99.2	100.0	100.0	99.3	100.0
E	71.9	53.5	80.0	79.6	68.2	84.6	96.5	100.0	100.0	99.2	100.0	100.0	99.3	100.00

Appendix 8:F.

Detailed analyses of proportions of response, with age, of differences between Groups C to I.

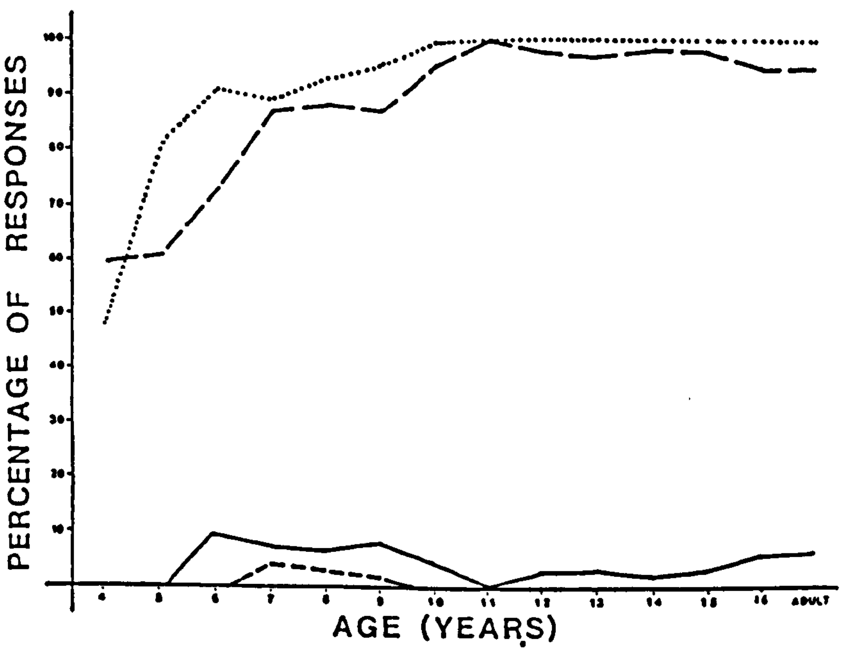
In this appendix responses to stimulus groups C to I (as outlined in the introduction to Appendices 8) are compared. A truncated version of this appendix is presented in Chapter 8.

Appendix 8:F.

Detailed analyses of proportions of response, with age, of differences between Groups C to I.

1) Differences in proportions of response, with age, between Groups H and I.

The table tops and legs are given in both of these groups and the expected response is the addition of one or two lines to complete the table top. All table legs should show ground plane and partial occlusion, thus the only expected variation is in the compulsory completion of the oblique or perspective table top. The proportions of response, with age, both on type of table top and type of depth cue produced, were compared across the two groups by a series of Kolmogorov Smirnov two sample, one tailed χ^2 approximation tests.



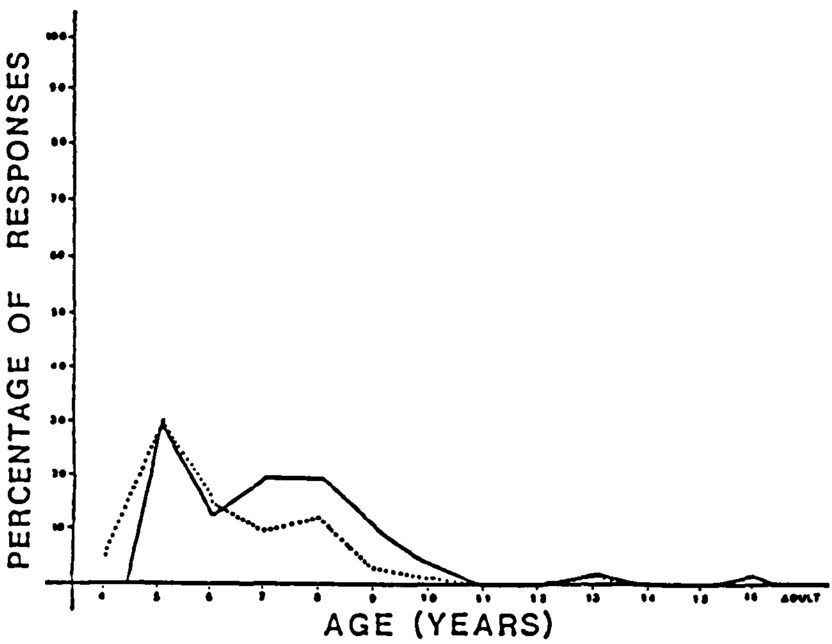
Key:- Oblique ············ Stimulus Group H ——— Stimulus Group I.
Perspective ------- Stimulus Group H — — — Stimulus Group I.

Figure 8:F1. *Proportions of oblique and perspective responses, with age, to Stimulus Groups H and I.*

These tests found significant differences in response to the two stimuli groups for the perspective table tops, and for the use of ground line, but failed to find any significant differences between the groups on the other responses. Comparison of Stimulus Group H vs. Stimulus Group I = Orthographic:- N. A.; Vertical Oblique:- $K\chi^2 = 1.15$, df = 2, $p > 0.05$; Oblique:- $K\chi^2 = 4.56$, df = 2, $p > 0.05$; Perspective:- $K\chi^2 = 14.97$, df = 2,

$p < 0.001$; No alteration:- $K\chi^2 = 3.17$, $df = 2$, $p > 0.05$; No Ground line:- $K\chi^2 = 2.31$, $df = 2$, $p > 0.05$; Ground line:- $K\chi^2 = 7.78$, $df = 2$, $p < 0.05$; Ground plane:- $K\chi^2 = 0.99$ $df = 2$, $p > 0.05$; Partial Occlusion:- $K\chi^2 = 2.27$, $df = 2$, $p > 0.05$.

It is worth noting here that firstly, that there was a much wider range of response than expected, and secondly, the failure to find any differences in the oblique response. Thus subjects not only changed the stimuli, but did so in a particular way.



Key:- .... Stimulus Group H ———— Stimulus Group I.

Figure 8:F2. Proportions of ground line response, with age, for Stimuli Groups H and I.

As expected, very few subjects changed the oblique stimuli to perspective, however, whilst only a small number of subjects changed the perspective stimuli to oblique, the proportions of subjects doing so, at each age, were not significantly different to those responding correctly to the oblique stimuli, as can be seen in Figure 8:F1.

The other significant difference found between the two groups is in the ground line response. As Figure 8:F2 shows, whilst some younger subjects in both groups alter the stimulus to provide a ground line response, the majority of such alterations attributable to Stimulus Group H are elicited at an earlier age than are those attributable to Stimulus Group I. Finally, although more subjects complete the table tops on the stimuli in Group H correctly, than they do the stimuli in Group I, a $K\chi^2$ test failed to find any significant differences between the two groups in the proportions of correct responses, with age,on the table tops ($K\chi^2$ = 0.25, df = 2, p > 0.05).

2) Differences in proportions of response, with age, between Groups H and F.

In both of these groups the expected completion is that of a table top in oblique projection, with table legs showing ground plane and partial occlusion. All Group H requires is the addition of one or two lines to complete the table top as the table legs are already given. The stimuli in Group F only provide the table tops, again requiring one, two or no lines for correct completion (the latter is Stimulus 22 in Group F). The only expected variation between the two groups is in the way in which the legs are completed. The proportions of response, with age, both on type of table top and type of depth cue produced, were compared across the two groups by a series of Kolmogorov Smirnov two sample, one tailed χ^2 approximation tests. These tests found significant differences in response to the two stimuli groups for the vertical oblique and oblique table tops, and for the use of ground plane and partial occlusion, but failed to find any significant differences between the groups on the other responses.

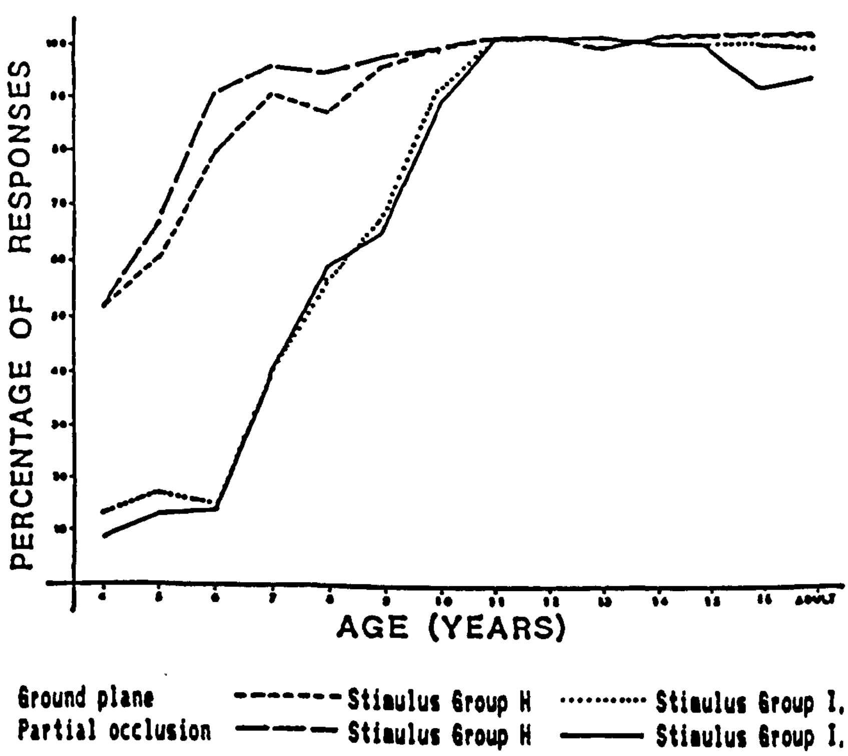
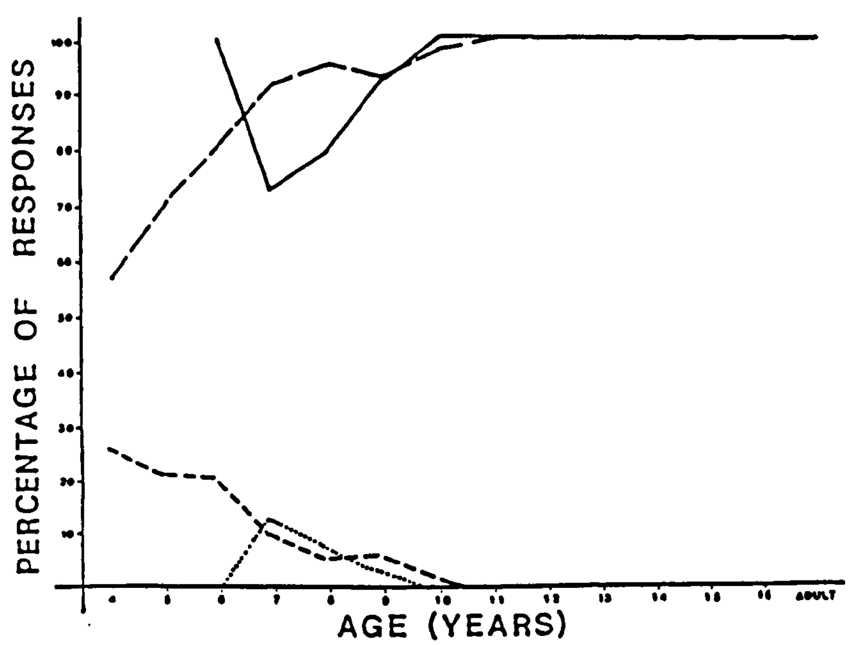


Figure 8:F3. *Proportions of Ground plane and Partial occlusion, with age, to Stimuli Groups H and F.*

Comparison of Stimulus Group H vs. Stimulus Group F = Orthographic:- N. A.; Vertical Oblique:- $K\chi^2 = 14.79$, df = 2, $p < 0.001$; Oblique:- $K\chi^2 = 6.5$, df = 2, $p < 0.05$; Perspective:- $K\chi^2 = 2.82$, df = 2, $p > 0.05$; No Ground line:- $K\chi^2 = 3.95$, df = 2, $p > 0.05$; Ground line:- $K\chi^2 = 1.84$, df = 2, $p > 0.05$; Ground plane:- $K\chi^2 = 56.98$ df = 2, $p < 0.001$; Partial Occlusion:- $K\chi^2 = 64.08$, df = 2, $p < 0.001$.

Many more subjects used no ground line and ground line in Group F than in Group H, however the tests failed to find any significant differences between the two groups in profiles of the proportions of subjects doing so at each age. Figure 8:F3 illustrates that this was not the case for the use of ground plane and partial occlusion, where, as expected there were major differences between the two groups.



Key:- Stimulus 16 [ ] .... Vertical oblique ———— Oblique.
Stimulus 18 [ ] -------- Vertical oblique — — — Oblique.

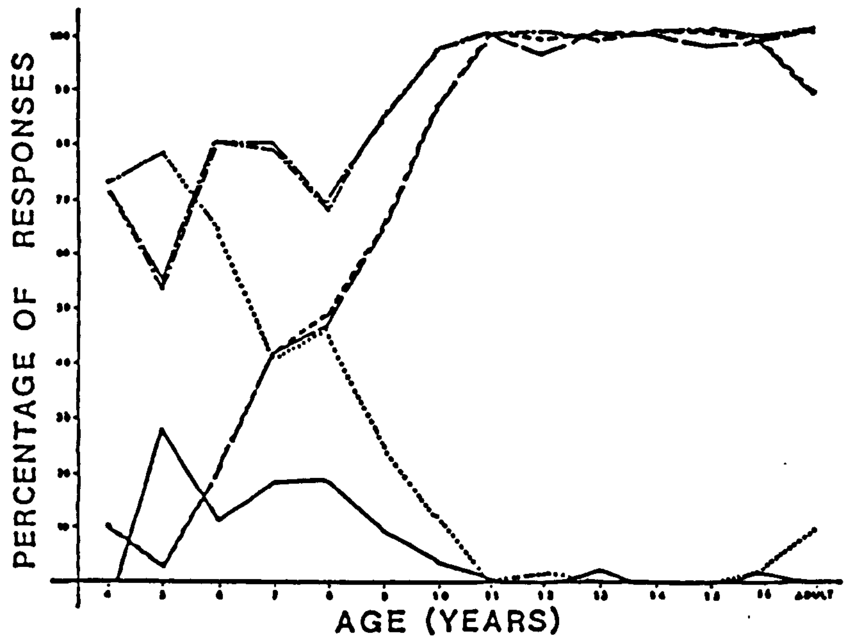
Figure 8:F4. Proportions of Vertical oblique and Oblique responses, with age, to Stimuli H18 and F16.

The significant differences found between the two groups in the use of vertical oblique and oblique projection on the table tops is less expected. However reference to the previous section shows that there were differences in the way in which the table tops were completed within Group F. Stimulus F22 requires no lines to be added for a correct completion, and the majority of the variation found within Group F appears to be attributable to this. The statistical comparisons applied here rely upon the amalgamated responses for both groups, and thus could be affected by a lack of direct comparability between the two groups caused by the inclusion of a completed table top in Group F but not in Group H. Two individual stimuli, one from each group, are directly comparable, namely:- F16 and H18. $K\chi^2$ tests on the two stimuli show significant differences in the oblique response, but fail to find any significant differences in the vertical oblique response. Vertical Oblique:- $K\chi^2 = 2.29$, df = 2, $p > 0.05$; Oblique:- $K\chi^2 = 10.38$, df = 2, $p < 0.01$. Figure 8:F4 illustrates that the inclusion of the table legs results in a greater proportion of the younger children completing the table top in oblique projection.

3) Differences in proportions of response, with age, between Groups I and G.

In both of these groups the expected completion is that of a table top in perspective, with table legs showing ground plane and partial occlusion. All Group I requires is the addition of one or two lines to complete the table top as the table legs are already given. The stimuli in Group G only provide the table tops, again requiring one, two or no lines for correct completion (the latter is Stimulus 3 in Group G). The only expected variation between the two groups is in the way in which the legs are completed. The proportions of response, with age, both on type of table top and type of depth cue produced, were compared across the two groups by a series of Kolmogorov Smirnov two sample, one tailed χ^2 approximation tests. These tests found significant differences in response to the two stimuli groups for the vertical oblique and perspective table tops, and for the use of ground line, ground plane and partial occlusion, but failed to find any significant differences between the groups on the other responses. Comparison of Stimulus Group I vs. Stimulus Group G = Orthographic:- N. A.; Vertical Oblique:- $K\chi^2 = 16.62$, df = 2, $p < 0.001$; Oblique:- $K\chi^2 = 1.56$, df = 2, $p > 0.05$; Perspective:- $K\chi^2 = 6.29$, df = 2, $p < 0.05$; No Ground line:- $K\chi^2 = 2.58$, df = 2, $p > 0.05$; Ground line:- $K\chi^2 = 12.7$, df = 2, $p < 0.01$; Ground plane:- $K\chi^2 = 55.35$ df = 2, $p < 0.001$; Partial Occlusion:- $K\chi^2 = 62.15$, df = 2, $p < 0.001$.

As in the previous section, stimuli with the table legs already given encourage many more responses that use ground plane and partial occlusion, as illustrated in Figure 8:F5. This figure also shows the no ground line responses for the two stimulus groups. The proportions of these responses, with age, were found to be significantly different. It can be seen that this significant difference is attributable to the fact that, of the total response, a greater percentage of older children continue to extend the back legs of the stimulus to give a ground line, when legs are included in the stimulus. This, taken with the findings presented above about the comparison between stimulus groups H and I indicates that not only are the table legs deliberately altered to provide a ground line, but that this effect is greater when the table top is in perspective, and is elicited from older children than when the table top is in oblique projection, or when no table legs are included in the stimulus.

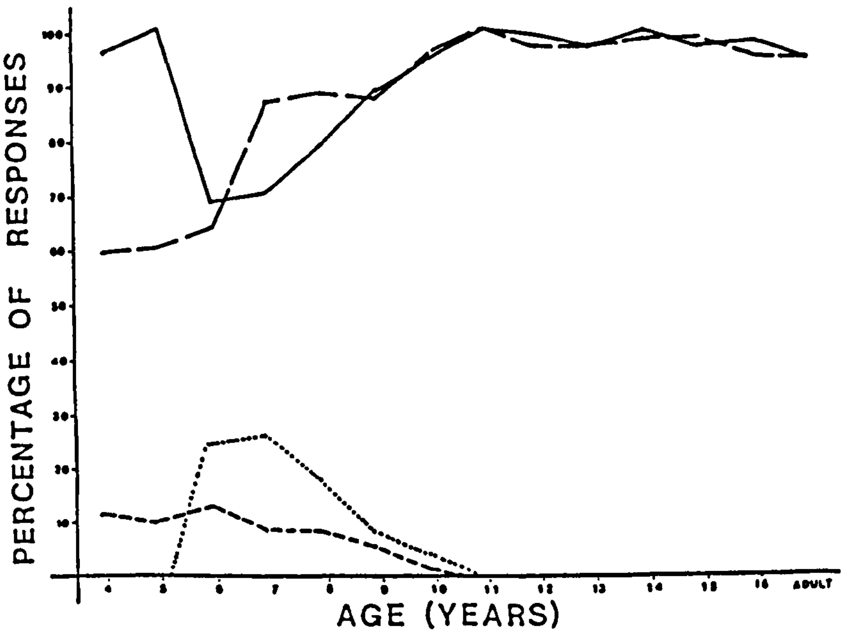


Key:-			
	Ground Line	.... Stimulus Group 6	——— Stimulus Group I.
	Ground plane	—·—·— Stimulus Group 6	- - - - Stimulus Group I.
	Partial occlusion	—·—·— Stimulus Group 6	——— Stimulus Group I.

Figure 8:F5. *Proportions of Ground line, Ground plane and Partial occlusion, with age, to Stimuli Groups 6 and I.*

It is worth noting here that both in this and earlier chapters the use of ground plane has been found to be in advance of the use of partial occlusion, however both Figure 8:F3 and 8:F5 show that the opposite appears to be the case for stimulus groups H and I. Of the subjects who do decide to alter the legs of the stimuli in these groups, more are concerned with producing a ground line than they are with producing no partial occlusion.

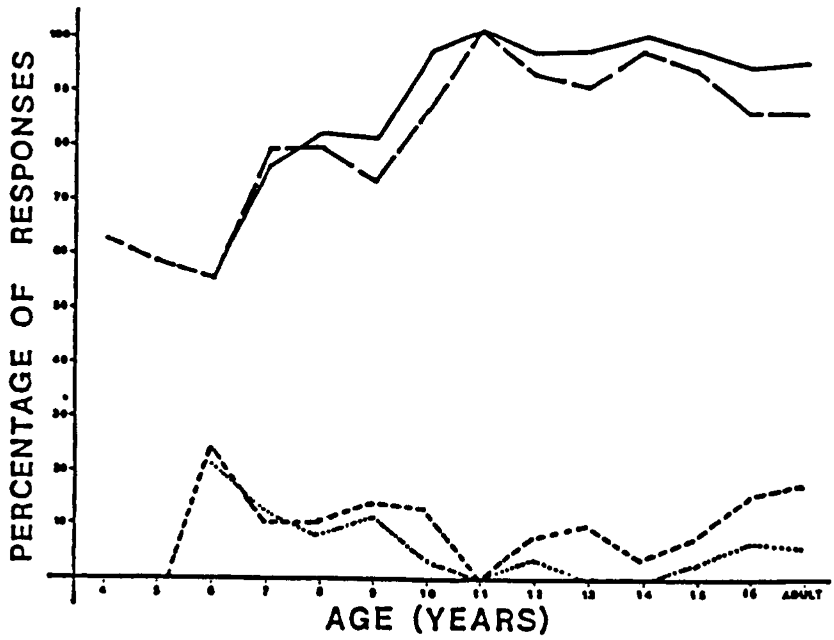
The significant differences found between the two groups in the use of vertical oblique projection and perspective on the table tops is of interest. Figure 8:F6 shows the complexity of the interaction. The majority of variance in the perspective response appears to be attributable to the very small number of four and five year old children attempting to alter the table top away from perspective when presented with a table top on its own.



Key:- Vertical oblique .... Stimulus Group 6 ----- Stimulus Group I.
Perspective ——-· Stimulus Group 6 ——— Stimulus Group I.

Figure 8:F6. *Proportions of Vertical oblique and Perspective responses, with age, to Stimuli Groups 6 and I.*

The addition of legs appears to encourage alteration of the stimulus by very young children, thus, if the statistical analysis is restricted to subjects from seven years of age and older no significant differences are found between the stimulus groups for the table top responses (Vertical Oblique:- $K\chi^2 = 0.63$, df = 2, $p > 0.05$; Perspective:- $K\chi^2 = 0.82$, df = 2, $p > 0.05$. As in the last section, there were differences in the way in which the table tops were completed within Group G. Stimulus G3 requires no lines to be added for a correct completion, and the majority of the variation found within Group G appears to be attributable to this. The statistical comparisons applied here rely upon the amalgamated responses for both groups, and thus could be affected by a lack of direct comparability between the two groups caused by the inclusion of a completed table top in Group G but not in Group I. Two individual stimuli, one from each group, are directly comparable, namely:- G21 and I1. $K\chi^2$ tests on the two stimuli show significant differences in the oblique response, but fail to find any significant differences in the vertical oblique and perspective responses. Vertical Oblique:- $K\chi^2 = 0.06$, df = 2, $p > 0.05$; Oblique:- $K\chi^2 = 9.55$, df = 2, $p < 0.01$; Perspective:- $K\chi^2 = 0.2$, df = 2, $p > 0.05$.



Key:- Stimulus 1 [ ] ········· Oblique ——— Perspective.
Stimulus 21 [ ] - - - - Oblique — — - Perspective.

Figure 8:F7. Proportions of Oblique and Perspective responses, with age, to Stimuli I1 and 621.

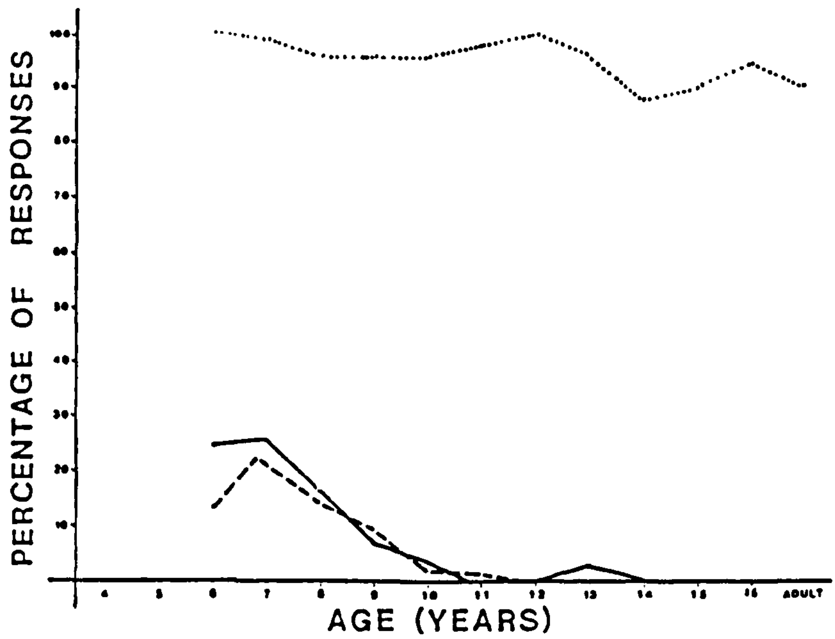
Figure 8:F7 illustrates that the inclusion of the table legs results in a greater proportion of the younger children completing the table top in oblique projection, even though the table legs are presented in perspective. It is interesting that this effect occurs regardless of the way in which the table top should be completed, and regardless of the way in which the legs are presented. This suggests a link between the presence of the depth cues of ground plane and partial occlusion (regardless of the system of projection used) and the desire to depict a table top in oblique projection.

4) Differences in proportions of response, with age, between Groups E, F, and G.

The stimuli in all three groups only provide the table tops, requiring one, two or no lines for correct completion. The groups vary in the form of table top expected, thus Group E expects a vertical oblique table top, F an oblique top, and G a top in perspective. Because no table legs are given it is expected that the table legs will be drawn in a similar manner across all groups. The proportions of response, with age, both on type of table top and type of depth cue produced, were compared across the three groups by a series of Kolmogorov Smirnov two sample, one tailed χ^2 approximation tests. These tests found significant differences across all measures of Group E against Group F and Group G, except for the perspective response between E and G. They also found significant differences on the oblique and perspective measures between groups F and G, but failed to find any significant differences between the groups on the other responses. Comparison of Stimulus Group E vs. Stimulus Group F = Orthographic:- N. A.; Vertical Oblique:- $K\chi^2 = 85.9$, df = 2, $p < 0.001$; Oblique:- $K\chi^2 = 20.07$, df = 2, $p < 0.001$; Perspective:- $K\chi^2 = 11.95$, df = 2, $p < 0.01$; No Ground line:- $K\chi^2 = 70.95$, df = 2, $p < 0.001$; Ground line:- $K\chi^2 = 96.59$, df = 2, $p < 0.001$; Ground plane:- $K\chi^2 = 20.11$, df = 2, $p < 0.001$; Partial Occlusion:- $K\chi^2 = 42.34$, df = 2, $p < 0.001$. Comparison of Stimulus Group E vs. Stimulus Group G = Orthographic:- N. A.; Vertical Oblique:- $K\chi^2 = 101.22$, df = 2, $p < 0.001$; Oblique:- $K\chi^2 = 16.26$, df = 2, $p < 0.001$; Perspective:- $K\chi^2 = 3.37$, df = 2, $p > 0.05$; No Ground line:- $K\chi^2 = 56.89$, df = 2, $p < 0.001$; Ground line:- $K\chi^2 = 94.81$, df = 2, $p < 0.001$; Ground plane:- $K\chi^2 = 19.96$, df = 2, $p < 0.001$; Partial Occlusion:- $K\chi^2 = 46.71$, df = 2, $p < 0.001$. Comparison of Stimulus Group F vs. Stimulus Group G = Orthographic:- N. A.; Vertical Oblique:- $K\chi^2 = 0.89$, df = 2, $p > 0.05$; Oblique:- $K\chi^2 = 9.16$, df = 2, $p < 0.02$; Perspective:- $K\chi^2 = 29.74$, df = 2, $p < 0.01$; No Ground line:- $K\chi^2 = 4.48$, df = 2, $p > 0.05$; Ground line:- $K\chi^2 = 2.16$, df = 2, $p > 0.05$; Ground plane:- $K\chi^2 = 0.78$, df = 2, $p > 0.05$; Partial Occlusion:- $K\chi^2 = 0.77$, df = 2, $p > 0.05$.

The comparison of responses for Stimulus Groups F and G produces the expected results. The only area of difference between the two is that of the forced response, oblique or perspective table tops respectively. This is attributable to the responses of a small proportion of older subjects who changed the perspective stimuli to form a table top in oblique projection. It is noticeable that no older subjects changed the oblique top to perspective. These findings suggest that older subjects prefer to complete a table top in oblique projection rather than perspective, and show that development in the way in which the table legs are depicted is not dependant upon the table top is presented in oblique projection or perspective.

The stimuli in Group E force a vertical oblique response on the table top, this produces a complex effect upon all the measures of response. Figure 8:F8 illustrates the vertical oblique response for the three groups. It can be seen that a small proportion of older subjects alter the stimuli in Group E away from Vertical oblique, thus providing substantially different age profiles to those obtained from Groups F and G.

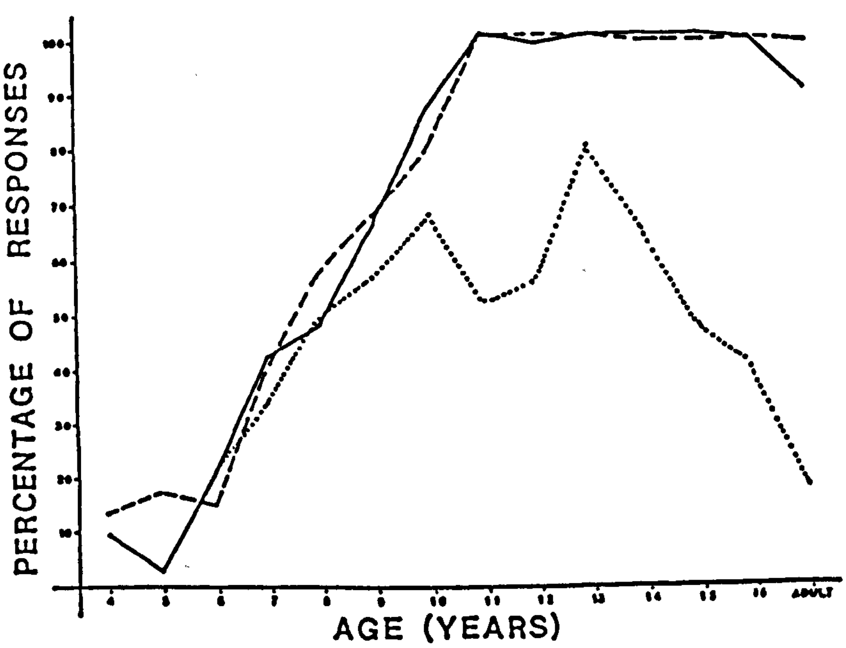


Key:- ············ Stimulus Group E - - - - - Stimulus Group F ——— Stimulus Group G.

Figure 8:F8. *Vertical Oblique response on Stimulus Groups E, F, and G.*

Reference to Appendix 8:D shows that, across these three stimulus groups, the opposite effect occurs for oblique projection and perspective. In both groups F and G it is the younger subjects who alter the stimuli away from the expected table top to provide a table top in vertical oblique. Thus, of the small proportion of subjects at any age who alter the stimulus, it is the younger ones who alter it to provide a table top in vertical oblique projection, and the older ones who have been presented with a table top in perspective who alter it to one in oblique projection. However an examination of the proportions of correct responses on the three stimulus groups shows that these effects fail, marginally, to reach statistical significance. Group F Oblique vs. Group G Perspective:- $K\chi^2$ = 0.21, df = 2, $p > 0.05$; Group E Vertical oblique vs. Group G Perspective:- $K\chi^2$ = 5.16, df = 2, $p > 0.05$; Group E Vertical oblique vs. Group F Oblique:- $K\chi^2$ = 5.21, df = 2, $p > 0.05$).

None of the stimuli in groups E, F, and G include table legs. Whilst tests failed to find significant differences between groups F and G in the way table legs were completed, Group E was found to be significantly different to the other two groups on all table leg measures. Reference to the individual group profiles in Appendix 8:D shows the complexity of the table leg response in Group E, here Figure 8:F9 simplifies this by showing the comparative ways in which ground plane is used in all three groups. It can be seen that until about ten years of age an increasing proportion of subjects, with age and in all three groups, produce ground plane. This increasing use of ground plane continues in both groups F and G, until 100% of subjects are using ground plane and partial occlusion at eleven years of age, and is mirrored by an equivalent decrease in the use of ground line, and to a lessor extent, no ground line. This pattern does not hold in Group E. Here, between ten and thirteen years of age there is a partial decrease, low plateau, and then slight increase in the use of ground plane, mirrored by an increase, and then decrease in the use of no ground line. From thirteen onwards there is a steady decrease, with age, in the use of ground plane, mirrored by an increase in the use of ground line, and no ground line. In Group E the age profile for the use of partial occlusion is significantly different to that of the use of ground plane ($K\chi^2$ = 9.99, df = 2, $p < 0.01$).



Key:- ·········· Stimulus Group E -----Stimulus Group F ——— Stimulus Group G.

Figure 8:F9. *Proportions in the use of Ground plane, with age, on Stimulus Groups E, F, and G.*

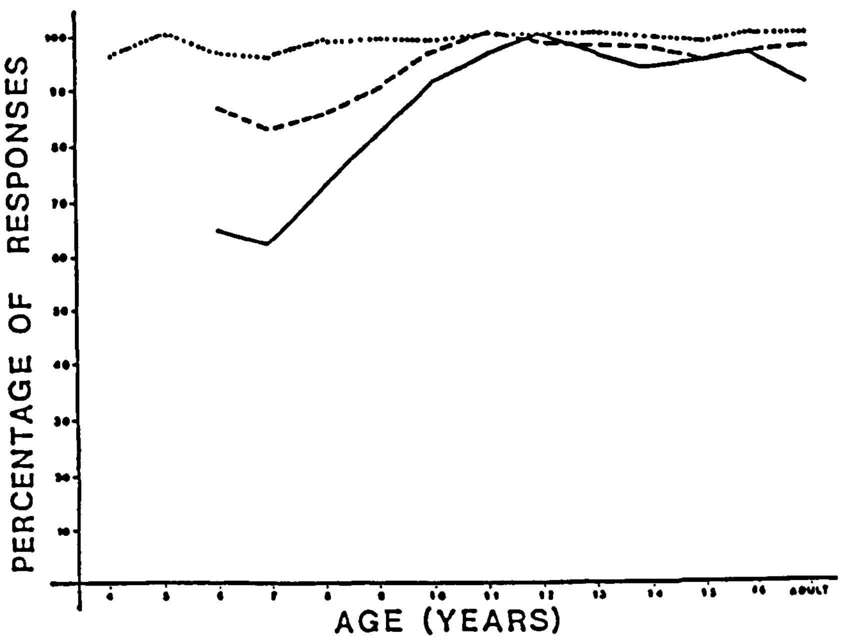
Stimuli in groups E (vertical oblique top) and G (perspective top) all present the subject with a single line at the bottom of the table top from which to draw the legs. If subjects were not sensitive to the form of the table top one would expect similar development in the use of depth cues across all these stimuli, as appears to occur until ten years of age.

Such development also occurs across the oblique stimuli where the line at the bottom of the table top is the one nearly always used in the production of ground line. Until this age it could be argued that subjects are just reacting to this bottom line. However, the vast majority of older subjects use the bottom line of the perspective table top, but use the bottom and side lines of the oblique top when producing a ground plane. The similarity between the age profiles of the ground plane and partial occlusion responses shows that very few subjects produced ground plane by extending the table legs from the back corners of the table. Thus older subjects do not respond to the vertical oblique stimuli as they do to the perspective stimuli. The significant difference between the age profiles of ground plane and partial occlusion show that many of the subjects produce ground plane by extending the legs from the back corners of the table top, whilst an increasing proportion of other subjects, with age, produce either a plan view of a table (no ground line) or extend all the legs to a ground line. They might be responding to figural biases caused by the square shape of the stimulus, however the lack of difference between the responses to the perspective and oblique stimuli suggests that older subjects respond in this manner because they are attempting to match the table legs to the way in which the top is drawn.

These findings reinforce earlier conclusions that development in the use of depth cues appears to be independent of the form of projection used in the depiction, and that subjects appear to become sensitive to the nature of their depiction at about ten years of age.

5) The effect that the number of lines given for completion in Groups E, F, and G has upon correctness of response.

For this analysis the stimuli were grouped according to the number of lines required for completion of the table top, thus stimuli E2, F7, and G15, all required two lines for completion, hence responses for these stimuli were amalgamated. Similarly, responses for stimuli E9, F16, and G21 were amalgamated to form the one line for completion group, and E14, F22, and G3, formed the no lines for completion group. A series of $K\chi^2$ tests on the proportions of correct responses, with age, for the three groups failed to find any significant differences between the three (No line vs. One line:- $K\chi^2 = 0.85$, df = 2, $p > 0.05$; Two line vs. One line:- $K\chi^2 = 1.81$, df = 2, $p > 0.05$; No line vs. Two line:- $K\chi^2 = 5.16$, df = 2, $p > 0.05$). However, as can be seen in Figure 8:F10, whilst the number of lines for completion has no statistically significant effect it would appear that, to a certain extent, the more lines that require completion, the more errors the younger children make.



Key:- .... No lines required ----- One line required ——— Two lines required.

Figure 8:F10. *Proportions of correct response, with age, on in relation of the number of lines required for completion on the table top.*

6) Differences in proportions of response, with age, between Groups C, and D.

None of the stimuli in these groups are intended to elicit only one form of response. The stimuli in Group C allow any form of response on either the table top or the table legs, whereas the stimuli in Group D are designed to encourage either perspective or oblique responses on the table top, and the majority of table leg responses. The proportions of response, with age, both on type of table top and type of depth cue produced, were compared across the three groups by a series of Kolmogorov Smirnov two sample, one tailed χ^2 approximation tests. These tests found significant differences across all measures except for those of ground plane and partial occlusion. Comparison of Stimulus Group C vs. Stimulus Group D = Orthographic:- $K\chi^2 = 6.52$, df = 2, $p < 0.05$; Vertical oblique:- $K\chi^2 = 99.82$, df = 2, $p < 0.001$; Oblique:- $K\chi^2 = 39.11$, df = 2, $p < 0.001$; Perspective:- $K\chi^2 = 60.83$, df = 2, $p < 0.001$; No Ground line:- $K\chi^2 = 12.91$, df = 2, $p < 0.01$; Ground line:- $K\chi^2 = 38.93$, df = 2, $p < 0.001$; Ground plane:- $K\chi^2 = 1.57$, df = 2, $p > 0.05$; Partial Occlusion:- $K\chi^2 = 2.61$, df = 2, $p > 0.05$.

Key:- Stimulus Group C ········ Vertical oblique — — Perspective,
Stimulus Group D - - - - Vertical oblique ——— Perspective,

Figure 8:F11, *Vertical Oblique and Perspective responses on Stimulus Groups C, and D.*

Stimulus Group D does not allow an orthographic response, hence the significant differences on this measure are expected. Stimuli in group C encourage 70% of the four year olds to respond orthographically, and encourage a low, but steady response across the remaining age groups, whereas only a very few subjects deliberately alter the stimulus to provide a similar response on stimuli in Group D. The oblique responses in both stimuli groups increase steadily with age, and whilst the $K\chi^2$ test showed significant differences between the age profiles for the two stimulus groups, the age profiles are also significantly correlated ($r = 0.892$, $v = 11$, $p < 0.001$), this is not the case for either the vertical oblique or perspective responses (Vertical oblique:- $r = 0.235$, $v = 12$, $p > 0.05$: Perspective:- $r = 0.064$, $v = 12$, $p > 0.05$). As Figure 8:F11 shows, the majority of younger children respond in perspective to stimuli in Group D (where they are provided with an oblique line upon which to construct their drawing), but in vertical oblique to stimuli in Group C (where only the front line of the table is provided). As with the oblique responses there are statistically significant differences between the Group D perspective response and the Group C vertical oblique response, when compared by a $K\chi^2$ test, but they are also significantly correlated ($K\chi^2$ = 15.56, df = 2, $p < 0.001$; r = 0.936, v = 12, $p < 0.001$).

The stimuli in Group D provided subjects with complete freedom to complete them in either oblique projection or perspective. If the two were conceptually equivalent one would expect them to be used in equal proportions at each age group, this did not occur. Whilst the younger subjects preferred to use perspective, the older subjects preferred to use oblique projection. It appears, to a certain degree, that under these conditions the younger subjects use vertical oblique projection and perspective equivalently, and that the use of these two is task dependant, but that the use of oblique projection develops with age independantly of the task.

There was very little difference between the two stimulus groups in the development of use of ground plane and partial occlusion. Reference to Appendix 8:D shows that the stimuli in Group C encourage a larger Ground line response and a lessor No ground line response from the younger subjects than do the stimuli in Group D. This effect does not appear to be related to the inclusion of the shortened table leg in Stimulus D8 (as seen in Appendix 8:D). The only other difference between these stimulus groups is the inclusion of the oblique line indicating the side of a table top, and thus it must be presumed that it is the inclusion of this line that causes the difference. To summarise, development in the use of ground plane and partial occlusion appears not to be task dependant, however, inclusion of a line that prevents the drawing of the table top in vertical oblique projection also significantly reduces the number of no ground line responses and increases the number of ground line responses.

7) A comparison of the proportions of response with age between Stimulus Group C and D, and E, F, and G.

The stimuli in Group C were designed to allow any form of response on the table top, those in Group D to allow either oblique or perspective responses on the table top, and Groups E, F, and G were designed to elicit vertical oblique, oblique, and perspective responses, respectively. All these groups allowed any form of response on the table legs. The proportions of response, with age, both on type of table top and type of depth cue produced, were compared across the three groups by a series of Kolmogorov Smirnov two sample, one tailed χ^2 approximation tests. These tests found significant differences across all measures except for those of ground plane and partial occlusion for C vs. G and F, for Perspective on C vs. G, and for Oblique and Perspective for C vs. E. Comparison of Stimulus Group C vs. Stimulus Group E = Orthographic:- N. A. ; Vertical oblique:- $K\chi^2$ = 128.27, df = 2, $p < 0.001$; Oblique:- $K\chi^2$ = 2.25, df = 2, $p > 0.05$; Perspective:- $K\chi^2$ = 1.17, df = 2, $p > 0.05$; No Ground line:- $K\chi^2$ = 32.75, df = 2, $p < 0.001$; Ground line:- $K\chi^2$ = 27.94, df = 2, $p < 0.001$; Ground plane:- $K\chi^2$ = 21.81, df = 2, $p < 0.001$; Partial Occlusion:- $K\chi^2$ = 46.95, df = 2, $p < 0.001$. Comparison of Stimulus Group C vs. Stimulus Group F = Orthographic:- N.A. ; Vertical oblique:- $K\chi^2$ = 14.84, df = 2, $p < 0.001$; Oblique:- $K\chi^2$ = 184.75, df = 2, $p < 0.001$; Perspective:- $K\chi^2$ = 34.38, df = 2, $p < 0.001$; No Ground line:- $K\chi^2$ = 19.8, df = 2, $p < 0.001$; Ground line:- $K\chi^2$ = 32.54, df = 2, $p < 0.001$; Ground plane:- $K\chi^2$ = 2.84, df = 2, $p > 0.05$; Partial Occlusion:- $K\chi^2$ = 1.5, df = 2, $p > 0.05$. Comparison of Stimulus Group C vs. Stimulus Group G = Orthographic:- N.A. ; Vertical oblique:- $K\chi^2$ = 19.05, df = 2, $p < 0.001$; Oblique:- $K\chi^2$ = 40.45, df = 2, $p < 0.001$; Perspective:- $K\chi^2$ = 3.71, df = 2, $p > 0.05$; No Ground line:- $K\chi^2$ = 15.08, df = 2, $p < 0.001$; Ground line:- $K\chi^2$ = 25.83, df = 2, $p < 0.001$; Ground plane:- $K\chi^2$ = 1.57, df = 2, $p > 0.05$; Partial Occlusion:- $K\chi^2$ = 0.66, df = 2, $p > 0.05$.

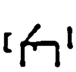
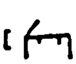
A similar series of tests comparing Stimulus Group D with Groups E, F, and G found significant differences on all measures apart from the perspective response on D vs. E, and the table leg responses on D vs G and D vs. F. Comparison of Stimulus Group D vs. Stimulus Group E = Orthographic:- N. A. ; Vertical oblique:- $K\chi^2$ = 22.0, df = 2, $p < 0.001$; Oblique:- $K\chi^2$ = 7.85, df = 2, $p < 0.05$; Perspective:- $K\chi^2$ = 5.29, df = 2, $p > 0.05$; No Ground line:- $K\chi^2$ = 41.45, df = 2, $p < 0.001$; Ground line:- $K\chi^2$ = 70.26, df = 2, $p < 0.001$; Ground plane:- $K\chi^2$ = 20.12, df = 2, $p < 0.001$; Partial Occlusion:- $K\chi^2$ = 41.47, df = 2, $p < 0.001$. Comparison of Stimulus Group D vs. Stimulus Group F = Orthographic:- N.A. ; Vertical oblique:- $K\chi^2$ = 70.08, df = 2, $p < 0.001$; Oblique:- $K\chi^2$ = 71.09, df = 2, $p < 0.001$; Perspective:- $K\chi^2$ = 9.03, df = 2, $p < 0.02$; No Ground line:- $K\chi^2$ = 4.9, df = 2, $p > 0.05$; Ground line:- $K\chi^2$ = 3.02, df = 2, $p > 0.05$; Ground plane:- $K\chi^2$ = 1.76, df = 2, $p > 0.05$; Partial Occlusion:- $K\chi^2$ = 0.76, df = 2, $p > 0.05$. Comparison of Stimulus Group D vs. Stimulus Group G = Orthographic:- N.A. ; Vertical oblique:- $K\chi^2$ = 81.12, df = 2, $p < 0.001$; Oblique:- $K\chi^2$ = 23.73, df = 2, $p < 0.001$; Perspective:- $K\chi^2$ = 107.57, df = 2, $p < 0.001$; No Ground line:- $K\chi^2$ = 0.2, df = 2, $p > 0.05$; Ground line:- $K\chi^2$ = 1.15, df = 2, $p > 0.05$; Ground plane:- $K\chi^2$ = 0.77, df = 2, $p > 0.05$;

Partial Occlusion:- $K\chi^2 = 3.01$, df = 2, $p > 0.05$.

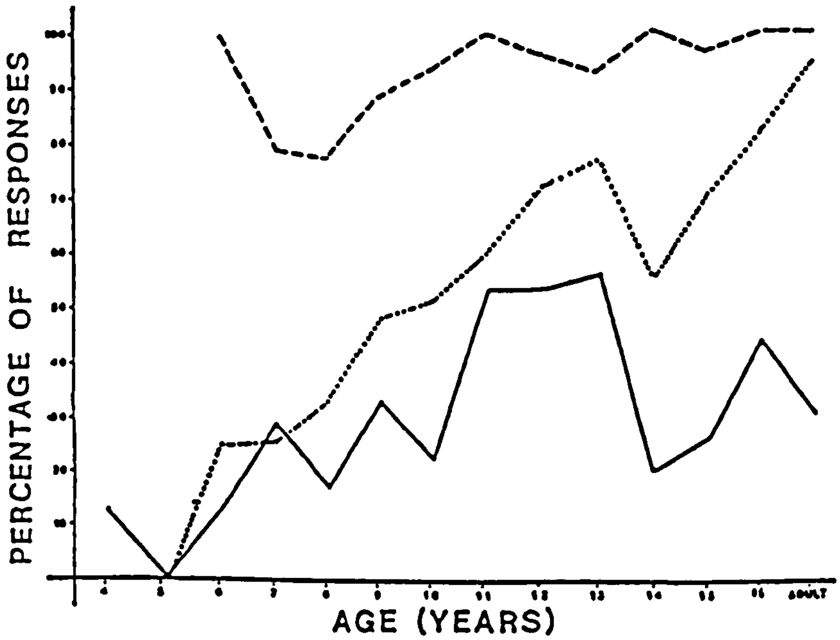
There are wide disparities in the proportions of subjects responding, with age, on all the table top measures in which $K\chi^2$ tests failed to find any significant differences. These disparities in proportion limit the psychological significance of the findings. The table leg responses do not suffer from this problem. Earlier a large difference was found between the way in which depth cues were used in response to stimuli in Group E as opposed to Groups F and G. The results presented here extend this finding. Development in the use of depth cues, and in particular those of ground plane and partial occlusion, appears to be similar across all the stimuli in groups C, D, F, and G. This form of development is not related to whether or not there is an oblique line on the table top, nor to the inclusion of some table legs in the stimulus, either extended from the front, or implicitly from the back of the table. The aspect of the stimuli in Group E that appears to be the prime cause of eliciting an unusual use of depth cues appears to be the forcing of older subjects into the use of vertical oblique projection on the table top.

To conclude, the main finding from these comparisons, supports earlier findings that the stimuli in Group E elicit unusual use of depth cues, and extends these findings to suggest that it is the presentation of the vertical oblique table top, rather than any other aspect of the stimuli, that causes this.

8) The effect of the position of one table leg in Stimuli D8, H4, and I11.

Stimuli D8 [], H4 [], and I11 [] were designed to vary only in the position of one table leg. Stimulus D8 could be completed correctly either in oblique projection or perspective, whereas the position of the additional table leg means that H4 should be completed in oblique projection, and I11 in perspective. The proportions of response, with age, both on type of table top and type of depth cue produced, were compared across the three stimuli by a series of Kolmogorov Smirnov two sample, one tailed χ^2 approximation tests. These tests found significant differences across the oblique and perspective measures, but failed to find any other significant differences. Comparison of Stimulus D8 vs. Stimulus H4 = Orthographic:- N. A. ; Vertical oblique:- $K\chi^2 = 1.29$, df = 2, $p > 0.05$; Oblique:- $K\chi^2 = 19.75$, df = 2, $p < 0.001$; Perspective:- $K\chi^2 = 18.85$, df = 2, $p < 0.001$; No Ground line:- $K\chi^2 = 3.55$, df = 2, $p > 0.05$; Ground line:-

$K\chi^2 = 0.99$, df = 2, $p > 0.05$; Ground plane:- $K\chi^2 = 3.26$, df = 2, $p > 0.05$; Partial Occlusion:- $K\chi^2 = 5.14$, df = 2, $p > 0.05$. Comparison of Stimulus D8 vs. Stimulus I11 = Orthographic:- N. A. ; Vertical oblique:- $K\chi^2 = 3.73$, df = 2, $p > 0.05$; Oblique:- $K\chi^2 = 21.78$, df = 2, $p < 0.001$; Perspective:- $K\chi^2 = 33.5$, df = 2, $p < 0.001$; No Ground line:- $K\chi^2 = 0.48$, df = 2, $p > 0.05$; Ground line:- $K\chi^2 = 1.3$, df = 2, $p > 0.05$; Ground plane:- $K\chi^2 = 0.8$, df = 2, $p > 0.05$; Partial Occlusion:- $K\chi^2 = 0.8$, df = 2, $p > 0.05$. Comparison of Stimulus H4 vs. Stimulus I11 = Orthographic:- N. A. ; Vertical oblique:- $K\chi^2 = 0.83$, df = 2, $p > 0.05$; Oblique:- $K\chi^2 = 8.89$, df = 2, $p < 0.02$; Perspective:- $K\chi^2 = 35.77$, df = 2, $p < 0.001$; No Ground line:- $K\chi^2 = 1.29$, df = 2, $p > 0.05$; Ground line:- $K\chi^2 = 0.68$, df = 2, $p > 0.05$; Ground plane:- $K\chi^2 = 1.86$, df = 2, $p > 0.05$; Partial Occlusion:- $K\chi^2 = 3.34$, df = 2, $p > 0.05$.

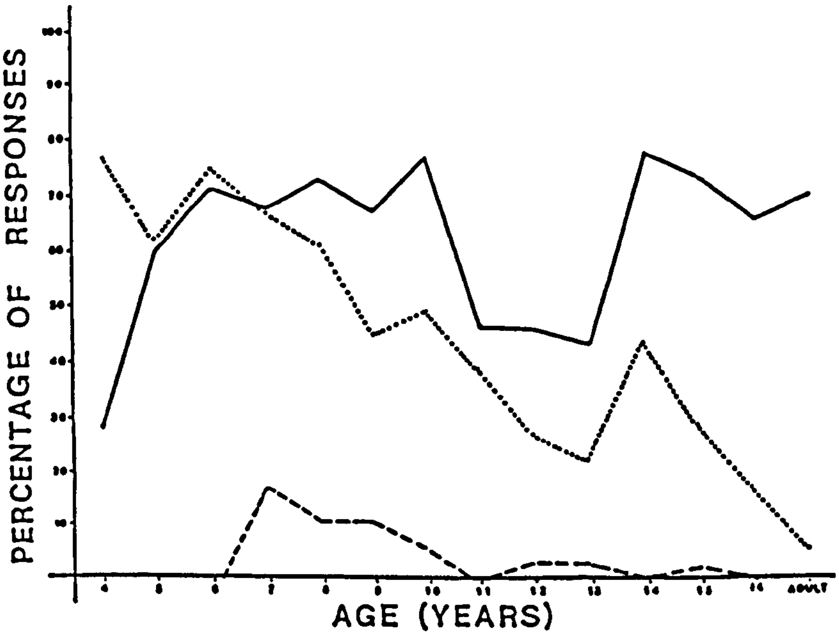


Key:- ·········· Stimulus D8 ----Stimulus H4 ——Stimulus I11

Figure 8:F12. *Proportions of Oblique response, with age, on Stimuli D8, H4, and I11.*

These findings support those presented earlier that development in the use of depth cues is generally stable across stimuli. The significant differences found on the oblique and perspective responses are illustrated in Figures 8:F12 and 8:F13 respectively. Figure 8:F12 illustrates that oblique projection is the preferred response, not only in Stimulus D8, where either oblique or perspective could be used, but also, for subjects between eleven and thirteen years of age, on Stimulus I11 where a perspective response was expected.

Figure 8:F13 illustrates that not only is the perspective response comparatively lower than the oblique response for all three stimuli, but that very few subjects make erroneous perspective responses on Stimulus H4, where an oblique response is expected.



Key:- ....Stimulus D8 ---- Stimulus H4 —— Stimulus I11

Figure 8:F13. *Proportions of Perspective response, with age, on Stimuli D8, H4, and I11.*

Appendix 8: G.

Detailed analyses of proportions of response, with age, of differences between Groups A and B, and C to I.

In this appendix responses to stimulus groups A and B (as outlined in the introduction to Appendices 8) are compared. They are also compared with responses to groups C to I. A truncated version of this appendix is presented in Chapter 8.

Appendix 8:G.

Detailed analyses of proportions of response, with age, of differences between Groups A and B and C to I.

1) Differences in proportions of response, with age, between Groups A and B.

All subjects were asked to both draw a table of their own (Group A, stimulus 6) and to choose from all the representations of a table the one they thought looked most like a table (Group B, stimulus 25). This design has several important points that need clarification.

When drawing their own table subjects had many depictions of tables, represented in various forms of projection, directly in front of them. Thus, although they were asked to draw their own table they were at perfect liberty to make an accurate copy of any of those that were on the sheet in front of them.

When subjects were asked to choose the representation that looked most like a table they were at perfect liberty to choose their own drawing. This design minimalises the problem that subjects might not wish to choose their own depiction because of feelings of inferiority about their own production in relation to the other neatly printed stimuli. Subjects had added lines of their own to all the stimuli, thus whatever they chose had some aspect of their own work in it. This does create a further problem in that some of the younger subjects altered all the stimuli, thus limiting the amount of choice available to them.

The design allows a direct comparison between how each subject draws a table and the form of representation that they think actually looks most like a table.

The proportions of response, with age, both on type of table top and type of depth cue produced, were compared across the two groups by a series of Kolmogorov Smirnov two sample, one tailed χ^2 approximation tests. These tests found significant differences in response to the two stimuli groups for all measures, apart from orthographic projection. Comparison of Stimulus A6 vs. Stimulus B25 = Orthographic:- $K\chi^2 = 3.4$, df = 2, $p > 0.05$; Vertical Oblique:- $K\chi^2 = 7.2$, df = 2, $p < 0.05$; Oblique:- $K\chi^2 = 236.16$, df = 2, $p < 0.001$; Perspective:- $K\chi^2 = 6.38$, df = 2, $p < 0.05$; No Ground Line:- $K\chi^2 = 14.75$, df = 2, $p < 0.001$; Ground Line:- $K\chi^2 = 25.34$, df = 2, $p < 0.001$; Ground Plane:- $K\chi^2 = 98.48$, df = 2, $p < 0.001$;

Partial Occlusion:- $K\chi^2 = 100.6$, df = 2, $p < 0.001$.

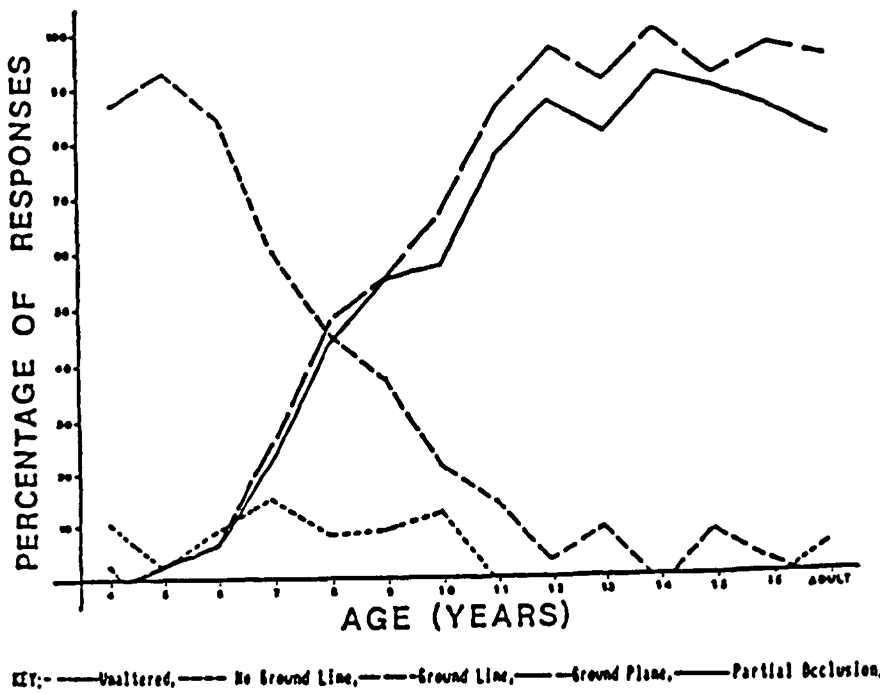


Figure 8:61. *The proportions of subjects drawing each type of table top, on Stimulus A6.*

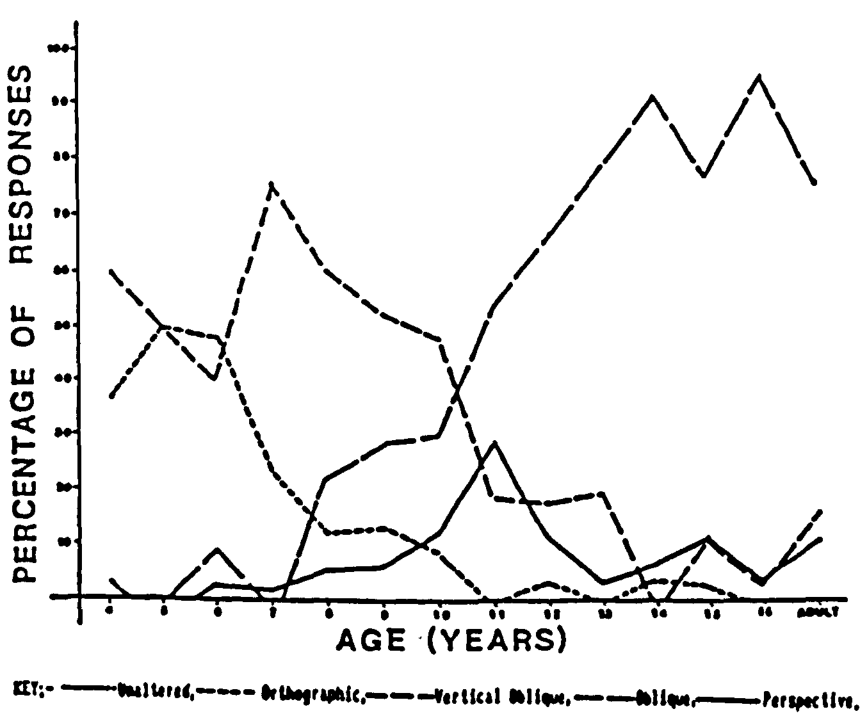


Figure 8:62. *The proportions of subjects drawing each type of depth cue, on Stimulus A6.*

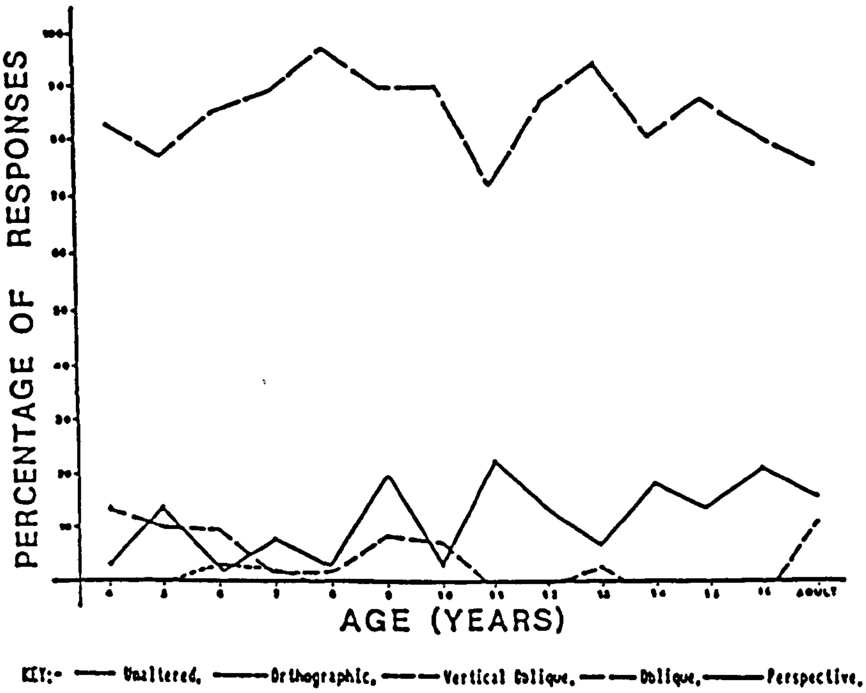


Figure 8;63. *The proportions of subjects drawing each type of table top, on Stimulus B25.*

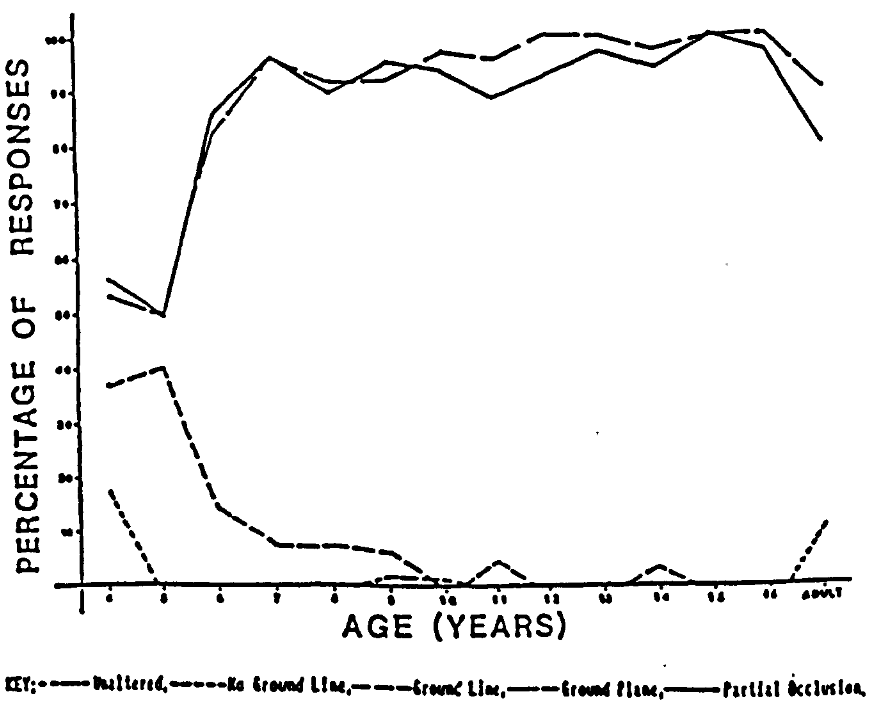


Figure 8;64. *The proportions of subjects drawing each type of depth cue, on Stimulus B25.*

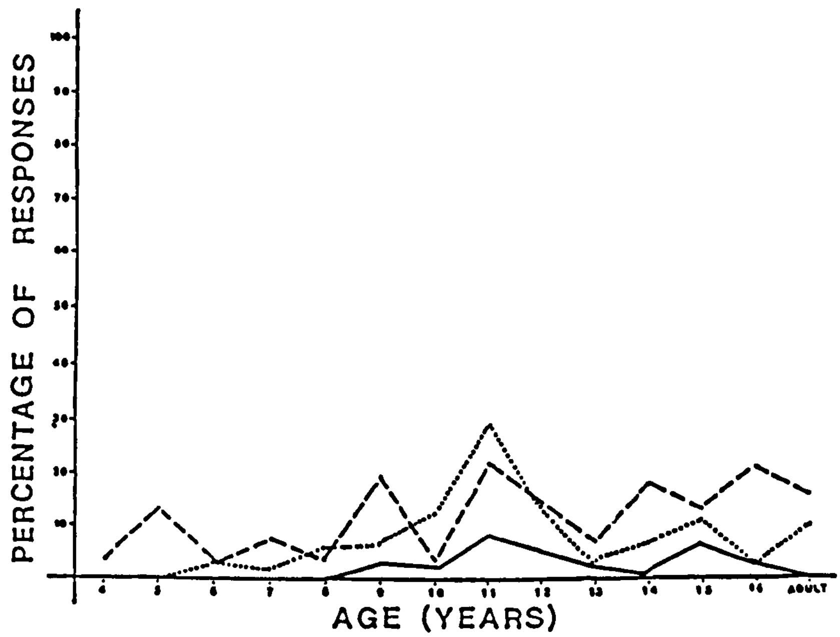
Figures 8:G1 to 8:G4 give the individual profiles for each stimulus. It can be seen that in the subjects own drawings there is clear development in the use of oblique projection, ground plane, and partial occlusion, whereas this is not the case in their choices. These three attributes are preferred by the vast majority of subjects at all ages, and show no development. It could be argued that marginal development occurs in preference for ground plane and partial occlusion is apparent in the responses of the very young subjects in Figure 8:G4, however, as discussed above, many of these very young children altered their stimuli to show a ground line and no partial occlusion, thus constraining their choice.

A direct comparison between each subjects own production and their choice shows that very few subjects, at any age, chose what they themselves had drawn, as can be seen in Table 8:G1.

AGE	4	5	6	7	8	9	10	11	12	13	14	15	16	20
Table top														
Orthographic			1											
Vert. Oblique	2	2		1			2	1						1
Oblique				1	3	10	8	9	14	8	14	22	19	12
Perspective							2	2	1	1	1	1		2
Depth cues														
No Gd. Line														1
Ground Line	2	2	1	1	1									
Ground Plane				1	2	10	12	12	15	9	15	23	19	14
Par. Occlusion				1	2	10	11	11	15	9	15	23	19	12
No. of S's	2	2	1	2	3	10	12	12	15	9	15	23	19	15

Table 8:G1. *The number of subjects, with age, who chose their own drawing as the one most like a table.*

A larger number of subjects chose depictions with table tops that were similar to their own, without choosing their own drawing. Thus nearly all subjects who drew a table top in oblique projection also chose one. The majority of younger subjects drew table tops in Orthographic or Vertical Oblique projection, yet few chose them as representations most like a table, however, of those who did choose them, the majority also drew a table top in that manner (approximately ten percent of subjects between the ages of four and six, and between nine and ten). This provides some support for the suggestion that some children do prefer their own form of depiction. The perspective response is more confused. Figures 8:G1 and 8:G3 appear to indicate that a small proportion of subjects at most ages both choose and prefer a table top in perspective, however this is not the case. As Figure 8:G5 shows, the majority of these subjects either draw a table top in perspective, but do not choose one in perspective or choose one in perspective but do not draw it.

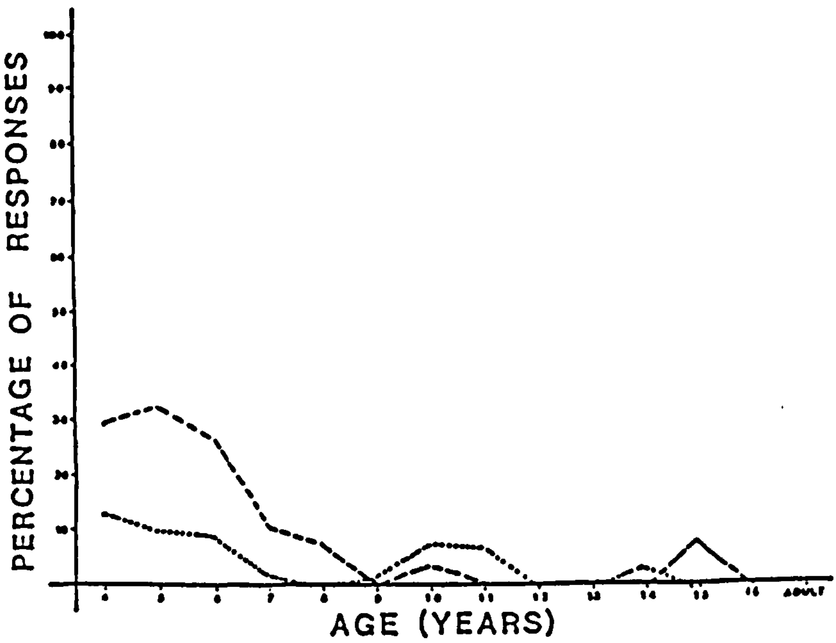


Key:- .... Stimulus A6 [Own] -----Stimulus B25 [Choice] ——— Both Own and Choice.

Figure 8:G5. *A comparison of the proportions of subjects making perspective responses on either Stimulus A6 or Stimulus B25, and those made by subjects on both stimuli.*

2) Differences in proportions of response, with age, between A and B, and data from Chapters 4 and 7.

Because of the design of this study it could be argued that these results have no real compatibility with those given in earlier chapters. This was examined by looking at the proportions of response, with age, both on type of table top and type of depth cue produced, across groups A and B, and the Imagination responses from Chapter 4, and the Choice of depiction Most Like a table from the previous chapter, using a series of Kolmogorov Smirnov two sample, one tailed χ^2 approximation tests. These tests found significant differences in the Vertical Oblique and No Ground Line responses for Choice of depiction, and for the Orthographic, Perspective, No Ground Line, and Ground Line responses for drawing the table, but failed to find any other significant differences. Comparison of Stimulus B25 vs. Most Like choice data = Orthographic:- N.A.; Vertical Oblique:- $K\chi^2 = 8.49$, $df = 2$, $p < 0.02$; Oblique:- $K\chi^2 = 5.66$, $df = 2$, $p > 0.05$; Perspective:- $K\chi^2 = 1.59$, $df = 2$, $p > 0.05$; No Ground Line:- $K\chi^2 = 7.05$, $df = 2$, $p < 0.05$; Ground Line:- $K\chi^2 = 1.53$, $df = 2$, $p > 0.05$; Ground Plane:- $K\chi^2 = 1.65$, $df = 2$, $p > 0.05$; Partial Occlusion:- $K\chi^2 = 1.01$, $df = 2$, $p > 0.05$.

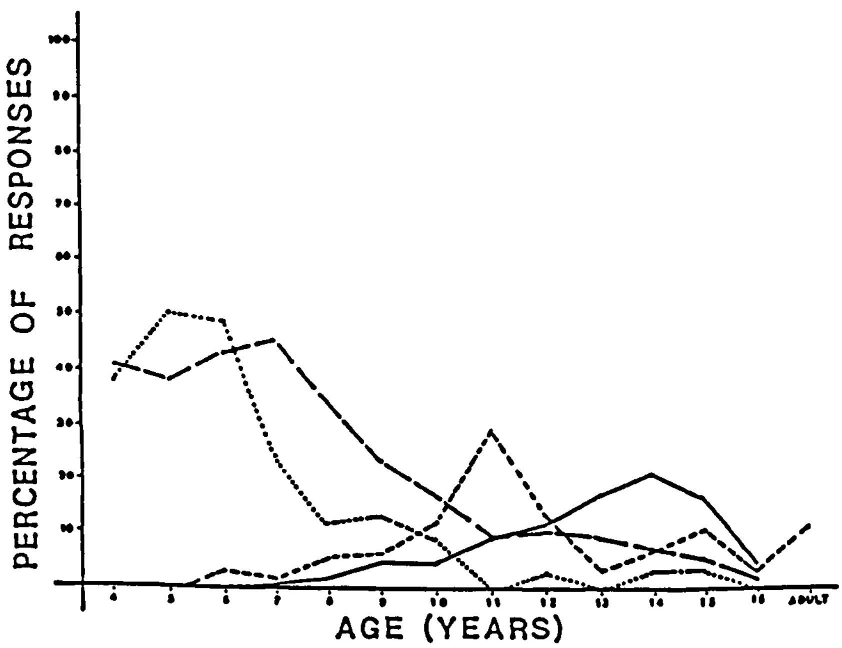


Key:- ········Stimulus B25 (choice) ----Most Like condition, Chapter 7.

Figure 8:66. *The proportions of subjects, with age, choosing a table top in vertical oblique projection as the one that looks most like a table when presented with stimuli they have completed (B25) or when presented with ready prepared stimuli (Chapter 7).*

Comparison of Stimulus A6 vs. Imagination data = Orthographic:- $K\chi^2 = 29.56$, $df = 2$, $p < 0.001$; Vertical Oblique:- $K\chi^2 = 2.75$, $df = 2$, $p > 0.05$; Oblique:- $K\chi^2 = 2.5$, $df = 2$, > 0.05; Perspective:- $K\chi^2 = 28.93$, $df = 2$, $p < 0.001$; No Ground Line:- $K\chi^2 = 11.81$, $df = 2$, $p < 0.01$; Ground Line:- $K\chi^2 = 14.25$, $df = 2$, $p < 0.001$; Ground Plane:- $K\chi^2 = 2.3$, $df = 2$, $p > 0.05$; Partial Occlusion:- $K\chi^2 = 5.98$, $df = 2$, $p > 0.05$.

The differences between the choice stimulus (B25) presented here, and the choice of projection system other subjects made when they were asked which depiction they thought looked most like a table are very small. There are two measures on which there were significant differences. The number of subjects using a No Ground Line response were very small in both cases, hence severely limiting the psychological significance of the differences found. The number of responses on the Vertical Oblique measure were larger, and, as Figure 8:G6 illustrates, a larger proportion of subjects between the ages of four and nine make this response when presented with fully completed stimuli (previous chapter), than they do if asked to choose from stimuli that they have to complete. However this effect is reversed for subjects between the ages of nine and eleven. These findings, taken in conjunction with those discussed in the section above about the relationship in the Vertical Oblique responses between the subjects own production and choice, strengthens the point that the choice of Vertical Oblique as the depiction most like a table may well imply different, age related, reasons for this choice.



Key:- Stimulus A6 (own) Imagination, Chapter 4.
Orthographic .... — — —
Perspective – – – – – – ———————

Figure 8:G7. *The proportions of subjects, with age, using orthographic projection and perspective on Stimulus A6 and when drawing a table from imagination.*

A larger number of significant differences were found between the responses to Stimulus A6 (own production, done with examples of different ways of depicting tables in front of the subjects and available for copying), and the drawing of a table from imagination (Chapter 4, done with no outside aid). Figure 8:G7 shows that more older subjects use orthographic projection, and less younger subjects use perspective, on the table tops when they are drawing unaided. Figure 8:G8 shows that more younger subjects use No Ground Line, and more older subjects use Ground Line when they are drawing unaided. Therefore, having depictions of tables available for copying appears to encourage, partially, the production of the forms of response used by older subjects. This effect is not universal, because the development of Oblique projection, Ground Plane and Partial Occlusion remains unaffected by the difference in the tasks.

Key:- Stimulus A6 (own) Imagination, Chapter 4.
No Ground Line
Ground Line

Figure 8:68. The proportions of subjects, with age, using No Ground Line and Ground Line on Stimulus A6 and when drawing a table from imagination.

3) Differences in proportions of response, with age, between Groups A and B, and Groups C to I.

A comparison was made between the subjects choice of depiction (Stimulus B25, the depiction that they thought looked most like a table), and the responses made on Stimulus groups C to I. This was examined by looking at the proportions of response, with age, both on type of table top and type of depth cue produced, across groups B to I using a series of Kolmogorov Smirnov two sample, one tailed χ^2 approximation tests. These tests found significant differences in the majority of the comparisons, only failing to find significant differences on the Ground Plane and Partial Occlusion measures when B25 was compared with Groups H and I. All the other comparisons that failed to find significant differences involved low subject numbers, thus limiting the psychological significance of the findings. Comparison of Stimulus B25 vs. Stimulus Group C = Orthographic:- $K\chi^2 = 4.92$, df = 2, $p > 0.05$; Vertical Oblique:- $K\chi^2 = 15.37$, df = 2, $p < 0.001$; Oblique:- $K\chi^2 = 232.69$, df = 2, $p < 0.001$; Perspective:- $K\chi^2 = 4.64$, df = 2, $p > 0.05$; No Ground Line:- $K\chi^2 = 17.23$, df = 2, $p < 0.001$; Ground Line:- $K\chi^2 = 48.73$, df = 2, $p < 0.001$; Ground Plane:- $K\chi^2 = 69.27$, df = 2, $p < 0.001$; Partial Occlusion:- $K\chi^2 = 65.84$, df = 2, $p < 0.001$.

Comparison of Stimulus B25 vs. Stimulus Group D = Orthographic:- $K\chi^2 = 10.77$, df = 2, $p < 0.01$; Vertical Oblique:- $K\chi^2 = 25.54$, df = 2, $p < 0.001$; Oblique:- $K\chi^2 = 108.93$, df = 2, $p < 0.001$; Perspective:- $K\chi^2 = 81.87$, df = 2, $p < 0.001$; No Ground Line:- $K\chi^2 = 9.81$, df = 2, $p < 0.01$; Ground Line:- $K\chi^2 = 15.7$, df = 2, $p < 0.001$; Ground Plane:- $K\chi^2 = 62.93$, df = 2, $p < 0.001$; Partial Occlusion:- $K\chi^2 = 60.96$, df = 2, $p < 0.001$.

Comparison of Stimulus B25 vs. Stimulus Group E = Orthographic:- $K\chi^2 = 5.35$, df = 2, $p > 0.05$; Vertical Oblique:- $K\chi^2 = 3.47$, df = 2, $p > 0.05$; Oblique:- $K\chi^2 = 15.9$, df = 2, $p < 0.001$; Perspective:- $K\chi^2 = 1.67$, df = 2, $p > 0.05$; No Ground Line:- $K\chi^2 = 15.53$, df = 2, $p < 0.001$; Ground Line:- $K\chi^2 = 17.08$, df = 2, $p < 0.001$; Ground Plane:- $K\chi^2 = 3.63$, df = 2, $p > 0.05$; Partial Occlusion:- $K\chi^2 = 27.17$, df = 2, $p < 0.001$.

Comparison of Stimulus B25 vs. Stimulus Group F = Orthographic:- N.A.; Vertical Oblique:- $K\chi^2 = 18.85$, df = 2, $p < 0.001$; Oblique:- $K\chi^2 = 6.22$, df = 2, $p < 0.05$; Perspective:- $K\chi^2 = 34.29$, df = 2, $p < 0.001$; No Ground Line:- $K\chi^2 = 12.59$, df = 2, $p < 0.01$; Ground Line:- $K\chi^2 = 8.32$, df = 2, $p < 0.02$; Ground Plane:- $K\chi^2 = 56.64$, df = 2, $p < 0.001$; Partial Occlusion:- $K\chi^2 = 70.02$, df = 2, $p < 0.001$.

Comparison of Stimulus B25 vs. Stimulus Group G = Orthographic:- $K\chi^2 = 10.05$, df = 2, $p < 0.01$; Vertical Oblique:- $K\chi^2 = 19.39$, df = 2, $p < 0.001$; Oblique:- $K\chi^2 = 11.13$, df = 2, $p < 0.01$; Perspective:- $K\chi^2 = 11.1$, df = 2, $p < 0.01$; No Ground Line:- $K\chi^2 = 13.09$, df = 2, $p < 0.01$; Ground Line:- $K\chi^2 = 16.99$, df = 2, $p < 0.001$; Ground Plane:- $K\chi^2 = 10.33$, df = 2, $p < 0.01$; Partial Occlusion:- $K\chi^2 = 85.89$, df = 2, $p < 0.001$.

Comparison of Stimulus B25 vs. Stimulus Group H = Orthographic:- N.A.; Vertical Oblique:- $K\chi^2 = 14.99$, df = 2, $p < 0.001$; Oblique:- $K\chi^2 = 8.91$, df = 2, $p < 0.02$; Perspective:- $K\chi^2 = 17.07$, df = 2, $p < 0.001$; No Ground Line:- $K\chi^2 = 1.9$, df = 2, $p > 0.05$; Ground Line:- $K\chi^2 = 11.17$, df = 2, $p < 0.01$; Ground Plane:- $K\chi^2 = 0.25$, df = 2, $p > 0.05$; Partial Occlusion:- $K\chi^2 = 0.25$, df = 2, $p > 0.05$.

Comparison of Stimulus B25 vs. Stimulus Group I = Orthographic:- $K\chi^2 = 12.1$, df = 2, $p < 0.01$; Vertical Oblique:- $K\chi^2 = 20.4$, df = 2, p <

0.001; Oblique:- $K\chi^2 = 1.77$, df = 2, $p > 0.05$; Perspective:- $K\chi^2 = 8.12$, df = 2, $p < 0.02$; No Ground Line:- $K\chi^2 = 6.28$, df = 2, $p < 0.05$; Ground Line:- $K\chi^2 = 23.68$, df = 2, $p < 0.001$; Ground Plane:- $K\chi^2 = 0.99$, df = 2, $p > 0.05$; Partial Occlusion:- $K\chi^2 = 3.92$, df = 2, $p > 0.05$.

A comparison was made between the subjects depiction (Stimulus A6), and the responses made on Stimulus groups C to I. This was examined by looking at the proportions of response, with age, both on type of table top and type of depth cue produced, across groups B to I using a series of Kolmogorov Smirnov two sample, one tailed χ^2 approximation tests. These tests found significant differences in the majority of the comparisons, only failing to find significant differences on the Oblique, Ground Plane and Partial Occlusion measures when A6 was compared with Stimulus Group C, and the Ground Line and Partial Occlusion measures when A6 was compared with Group G. All the other comparisons that failed to find significant differences involved low subject numbers, thus limiting the psychological significance of the findings. Comparison of Stimulus A6 vs. Stimulus Group C = Orthographic:- $K\chi^2 = 37.94$, df = 2, $p < 0.001$; Vertical Oblique:- $K\chi^2 = 17.28$, df = 2, $p < 0.001$; Oblique:- $K\chi^2 = 1.76$, df = 2, $p > 0.05$; Perspective:- $K\chi^2 = 8.16$, df = 2, $p < 0.02$; No Ground Line:- $K\chi^2 = 4.06$, df = 2, $p > 0.05$; Ground Line:- $K\chi^2 = 18.48$, df = 2, $p < 0.001$; Ground Plane:- $K\chi^2 = 2.65$, df = 2, $p > 0.05$; Partial Occlusion:- $K\chi^2 = 3.77$, df = 2, $p > 0.05$. The significant differences found here in the perspective response are attributable to A6 vs. C17 ($K\chi^2 = 11.48$, df = 2, $p < 0.02$). The significant differences found on the other responses are equally applicable to either A6 vs C17 or A6 vs. C12.

Comparison of Stimulus A6 vs. Stimulus Group D = Orthographic:- $K\chi^2 = 7.94$, df = 2, $p < 0.05$; Vertical Oblique:- $K\chi^2 = 68.08$, df = 2, $p < 0.001$; Oblique:- $K\chi^2 = 27.32$, df = 2, $p < 0.001$; Perspective:- $K\chi^2 = 88.95$, df = 2, $p < 0.001$; No Ground Line:- $K\chi^2 = 9.47$, df = 2, $p < 0.01$; Ground Line:- $K\chi^2 = 6.66$, df = 2, $p < 0.05$; Ground Plane:- $K\chi^2 = 6.55$, df = 2, $p < 0.05$; Partial Occlusion:- $K\chi^2 = 10.85$, df = 2, $p < 0.01$.

Comparison of Stimulus A6 vs. Stimulus Group E = Orthographic:- $K\chi^2 = 16.34$, df = 2, $p < 0.001$; Vertical Oblique:- $K\chi^2 = 133.31$, df = 2, $p < 0.001$; Oblique:- $K\chi^2 = 2.28$, df = 2, $p > 0.05$; Perspective:- $K\chi^2 = 2.58$, df = 2, $p > 0.05$; No Ground Line:- $K\chi^2 = 53.65$, df = 2, $p < 0.001$; Ground Line:- $K\chi^2 = 79.88$, df = 2, $p < 0.001$; Ground Plane:- $K\chi^2 = 22.64$, df = 2, $p < 0.001$; Partial Occlusion:- $K\chi^2 = 58.19$, df = 2, $p < 0.001$.

Comparison of Stimulus A6 vs. Stimulus Group F = Orthographic:- N.A.; Vertical Oblique:- $K\chi^2 = 12.4$, df = 2, $p < 0.01$; Oblique:- $K\chi^2 =$

184.4, df = 2, $p < 0.001$; Perspective:- $K\chi^2 = 48.96$, df = 2, $p < 0.001$; No Ground Line:- $K\chi^2 = 15.69$, df = 2, $p < 0.001$; Ground Line:- $K\chi^2 = 8.15$, df = 2, $p < 0.02$; Ground Plane:- $K\chi^2 = 9.03$, df = 2, $p < 0.02$; Partial Occlusion:- $K\chi^2 = 6.22$, df = 2, $p < 0.05$.

Comparison of Stimulus A6 vs. Stimulus Group G = Orthographic:- $K\chi^2 = 14.53$, df = 2, $p < 0.001$; Vertical Oblique:- $K\chi^2 = 15.82$, df = 2, $p < 0.001$; Oblique:- $K\chi^2 = 38.33$, df = 2, $p < 0.001$; Perspective:- $K\chi^2 = 21.85$, df = 2, $p < 0.001$; No Ground Line:- $K\chi^2 = 10.9$, df = 2, $p < 0.01$; Ground Line:- $K\chi^2 = 3.9$, df = 2, $p > 0.05$; Ground Plane:- $K\chi^2 = 6.54$, df = 2, $p < 0.02$; Partial Occlusion:- $K\chi^2 = 4.29$, df = 2, $p > 0.05$.

Comparison of Stimulus A6 vs. Stimulus Group H = Orthographic:- N.A.; Vertical Oblique:- $K\chi^2 = 16.4$, df = 2, $p < 0.001$; Oblique:- $K\chi^2 = 172.72$, df = 2, $p < 0.001$; Perspective:- $K\chi^2 = 25.12$, df = 2, $p < 0.001$; No Ground Line:- $K\chi^2 = 1.63$, df = 2, $p > 0.05$; Ground Line:- $K\chi^2 = 5.62$, df = 2, $p > 0.05$; Ground Plane:- $K\chi^2 = 99.01$, df = 2, $p < 0.001$; Partial Occlusion:- $K\chi^2 = 94.14$, df = 2, $p < 0.001$.

Comparison of Stimulus A6 vs. Stimulus Group I = Orthographic:- $K\chi^2 = 15.68$, df = 2, $p < 0.001$; Vertical Oblique:- $K\chi^2 = 13.95$, df = 2, $p < 0.001$; Oblique:- $K\chi^2 = 33.25$, df = 2, $p < 0.001$; Perspective:- $K\chi^2 = 18.3$, df = 2, $p < 0.001$; No Ground Line:- $K\chi^2 = 4.18$, df = 2, $p > 0.05$; Ground Line:- $K\chi^2 = 10.97$, df = 2, $p < 0.01$; Ground Plane:- $K\chi^2 = 80.98$, df = 2, $p < 0.001$; Partial Occlusion:- $K\chi^2 = 68.95$, df = 2, $p < 0.001$.

Figures 8:G9 to 8:G17 present these findings in a slightly more user friendly manner. In these figures each stimulus group is given a different type of line, thus:-

Group A Group B Group C
Group D Group E Group F
Group G Group H Group I.

Figure 8:G9 shows that there were very few orthographic responses to any of the stimuli, apart from Stimulus A6, when subjects were asked to draw their own table.

Figure 8:G10, looking at the vertical oblique response, shows that Group E stimuli encourage a high vertical oblique response at all ages, but that Group C stimuli elicit a higher vertical oblique response than is produced in Group A (subjects own drawing). None of the remaining groups encourage a high response as subjects had to deliberately alter the stimuli to produce one, though Groups G and F show a peak in vertical oblique response between six and eight years of age.

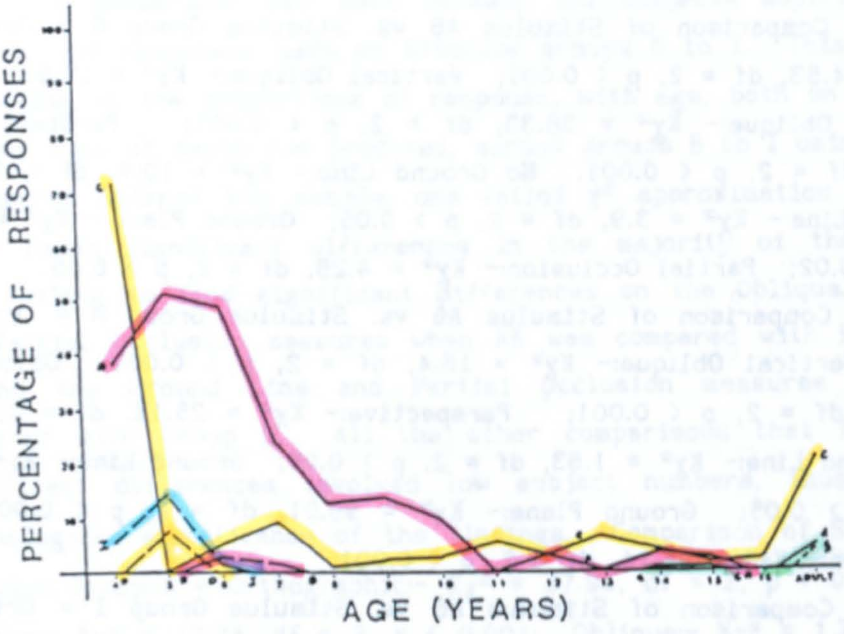


Figure 8:69. The use of orthographic projection in each stimulus group.

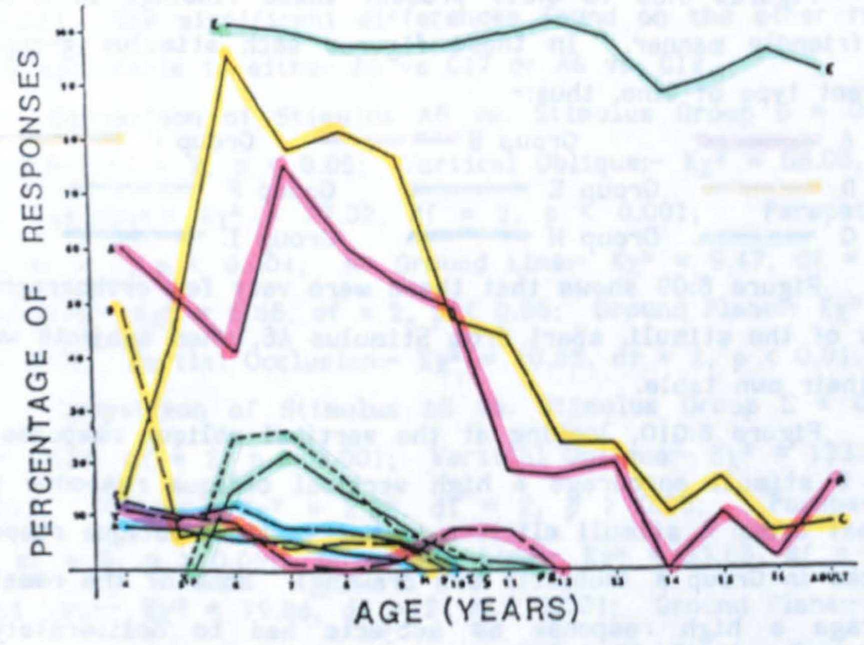


Figure 8:610. The use of vertical oblique projection in each stimulus group.

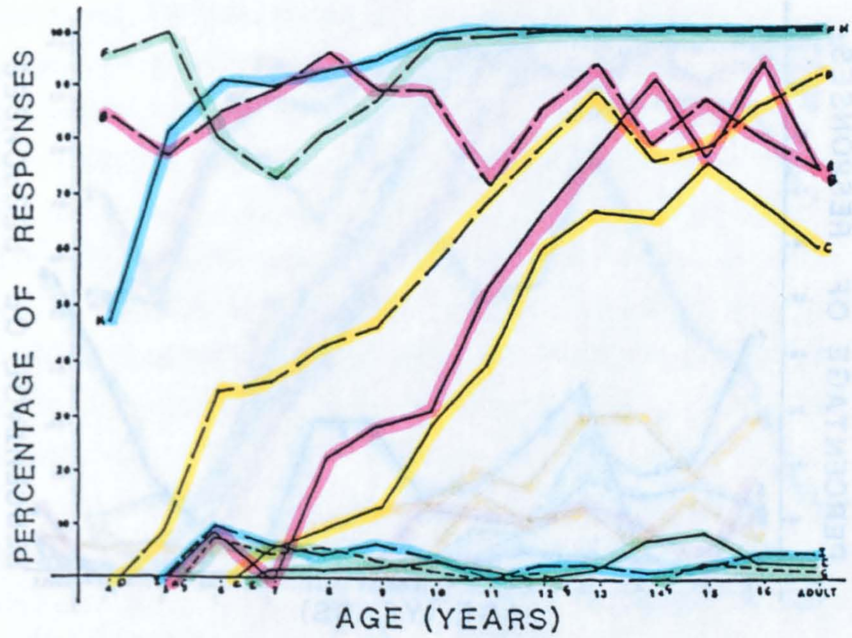


Figure 8;611. *The use of oblique projection in each stimulus group.*

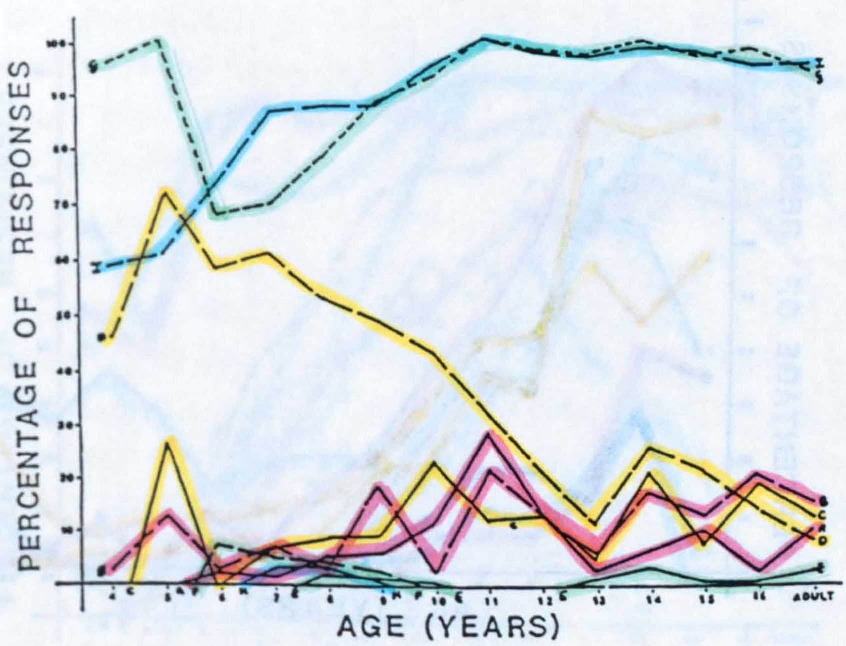


Figure 8;612. *The use of perspective in each stimulus group.*

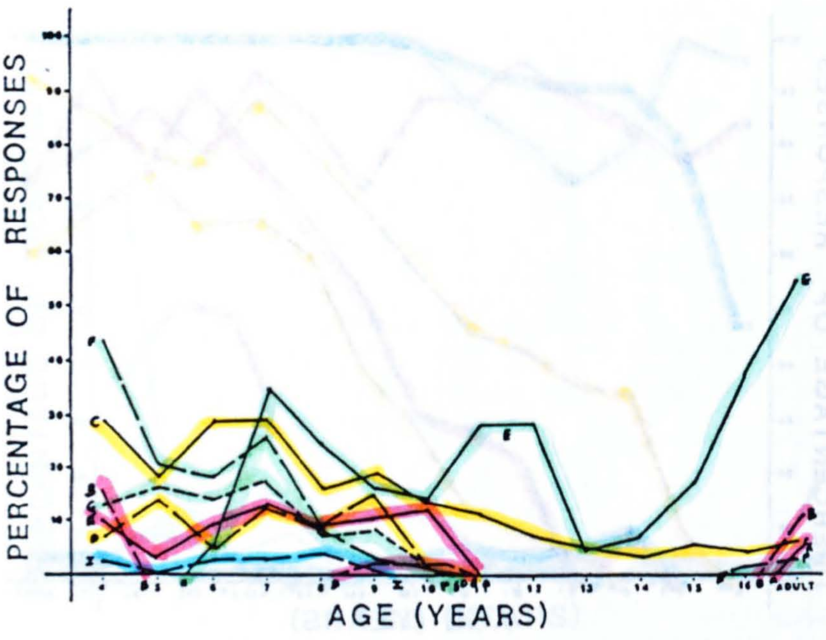


Figure 8:613. *The use of no ground line in each stimulus group.*

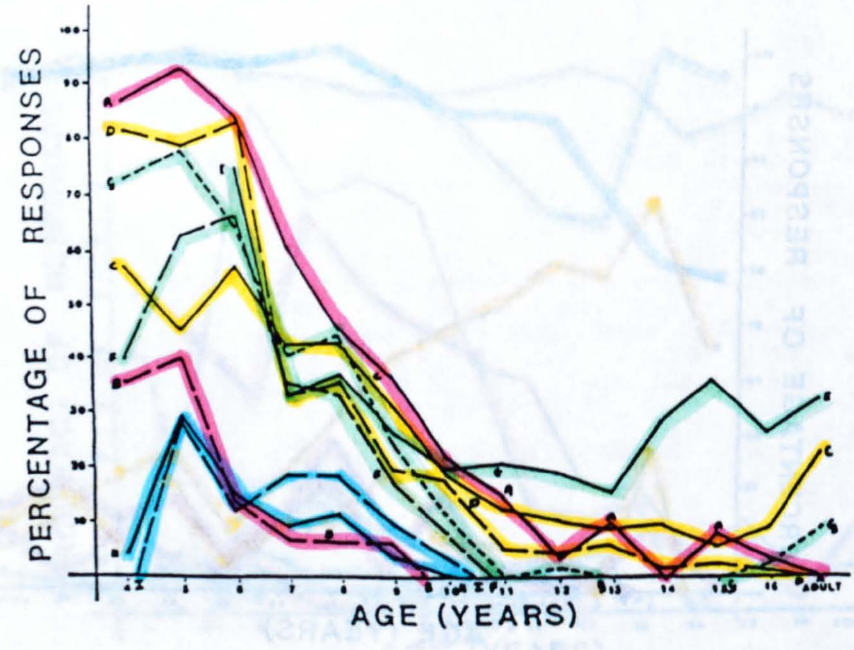


Figure 8:614. *The use of ground line in each stimulus group.*

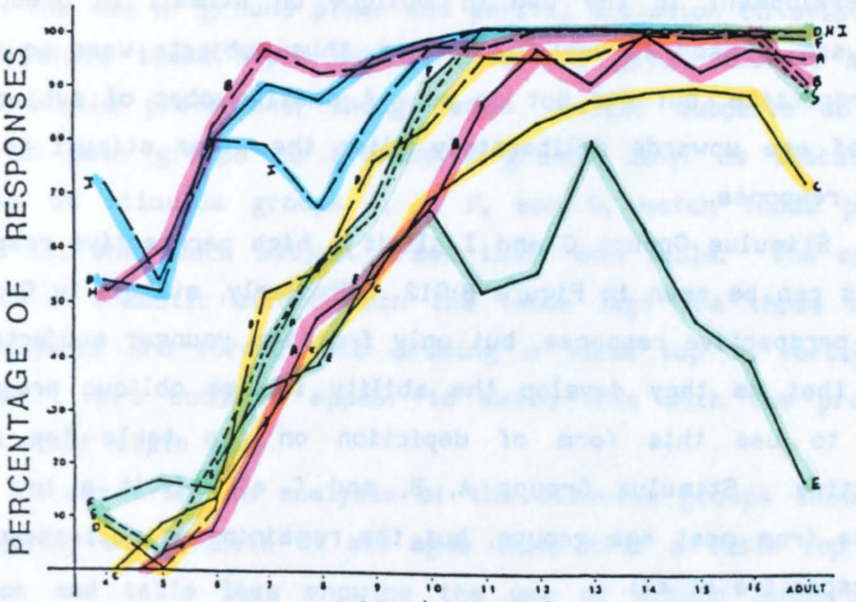


Figure 8;615. *The use of ground plane in each stimulus group.*

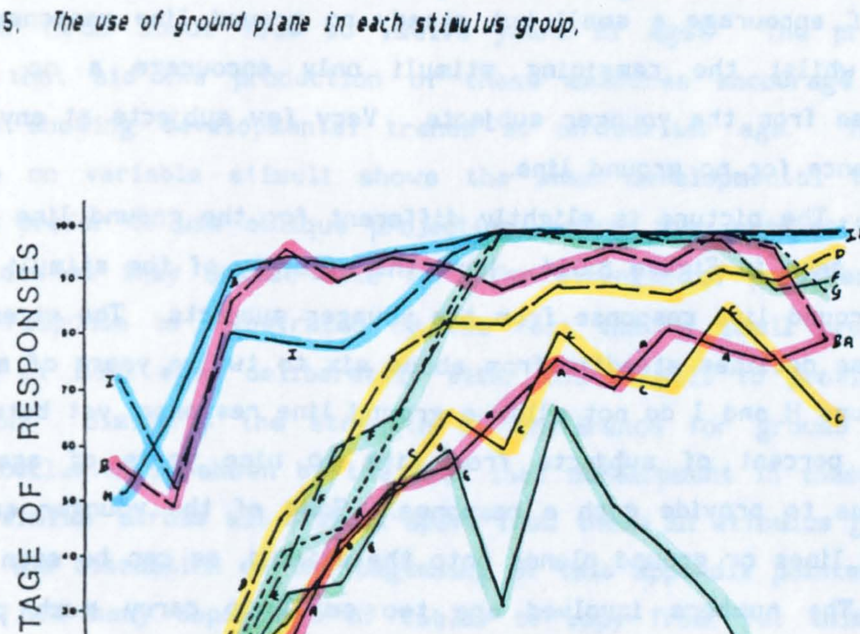


Figure 8;616. *The use of partial occlusion in each stimulus group.*

Stimulus groups F and H, as might be expected, elicit a high oblique response at all ages, as does Group B, the subjects choice of depiction most like a table, as can be seen in Figure 8:G11. Development in the subjects own production of oblique projection is closely correlated with development in the use of oblique on stimuli in Groups C and D. These were classed as variable groups, thus subjects were equally able to use perspective, but did not do so. A small number of subjects from six years of age upwards deliberately alter the other stimuli to provide an oblique response.

Stimulus Groups G and I elicit a high perspective response at all ages, as can be seen in Figure 8:G12. Similarly, stimuli in Group D elicit a high perspective response, but only from the younger subjects. It would appear that as they develop the ability to use oblique projection, they choose to use this form of depiction on the table top rather than perspective. Stimulus Groups A, B, and C all elicit a low perspective response from most age groups, but the remaining stimuli encourage hardly any perspective at all.

Figure 8:G13 shows that stimuli in Group E encourage the highest no ground line response, particularly from the older subjects. Stimuli in Group C encourage a small but steady no ground line response across all ages, whilst the remaining stimuli only encourage a no ground line response from the younger subjects. Very few subjects at any age show a preference for no ground line.

The picture is slightly different for the ground line response, as can be seen in Figure 8:G14. Here the majority of the stimuli encourage a high ground line response from the younger subjects. The strength of this response declines steadily from about six to twelve years of age. Stimuli in Groups H and I do not allow a ground line response, yet between ten and thirty percent of subjects from five to nine years of age, alter the stimulus to provide such a response. Some of the younger subjects drew ground lines or ground planes onto the stimuli, as can be seen in Appendix 8:A. The numbers involved are too small to carry much psychological significance, but the unexpected addition of these indicates that, for these subjects, an important aspect of the stimulus is its percieved possession of a ground line or a ground plane. This indicates that extending the legs to produce a ground line, on stimuli that initially possessed a ground plane is a deliberate action coinciding with the stated preference for ground line.

Figures 8:G15, and 8:G16, showing the ground plane and partial occlusion responses are very similar and will be discussed together. The majority of subjects at all ages think that a depiction showing ground plane and partial occlusion looks most like a table, and subjects show a developing ability to use these depth cues from about four to twelve years of age. The use of ground plane and partial occlusion on stimulus groups H and I, where these depth cues are already given, closely matches the subjects stated preference, though some younger subjects do alter the stimuli in both groups to provide a ground line, as discussed above. Responses on stimulus groups C, D, F, and G, match those produced on Stimulus A6, when each subject draws their own table. The only stimuli that have a dramatic effect upon the table legs are those in Group C, where subjects are forced into drawing a table top in vertical oblique projection. Here subjects appear to match this with the production of 'less advanced' depth cues.

To summarise an analysis of the stimulus groups shows that the vast majority of subjects at all ages think that a table top in oblique projection and table legs showing the use of ground plane and partial occlusion makes the depiction look most like a table. Subjects show a developing ability to use oblique projection, ground plane, and partial occlusion (from about four to twelve years of age). The provision of stimuli that aid the production of these measures encourage a similar response showing developmental trends at an earlier age. The oblique response on variable stimuli shows the same developmental trend, thus subjects prefer to use oblique projection, rather than perspective, and do so as soon as they become able to. The strength of preference for an oblique response is illustrated by the fact that a small proportion of subjects at most ages deliberately alter the stimuli to provide oblique projection. Similarly the strength of preference for ground plane and partial occlusion is shown by the fact that development in these measures is very similar across all stimuli apart from those in stimulus group E.

The discussion at the beginning of this appendix pointed out that subjects had many depictions of tables to copy from, yet this does not appear to have enabled them to complete the stimuli in the way that they think looks most like a table. Some subjects have deliberately altered the stimuli to accord with their normal production, and the use of oblique projection, ground plane, and partial occlusion develops with age in a relatively non-task dependant way.

APPENDIX TO CHAPTER 9. Ap.9. 1

'Meaning', and the Copying of Line Drawings of Tables.

* Data are contained in Chapter 9.

Ap.9. Lee, M., (1989), *When is an object not an object? The effect of 'meaning' upon the copying of line drawings.* British Journal of Psychology, 80, 15-37. Ap.9. 2

British Journal of Psychology (1989), 80, 15–37 Printed in Great Britain

When is an object not an object? The effect of 'meaning' upon the copying of line drawings

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A series of studies shows that errors in copying line drawings of a table are directly related to the knowledge that the lines represent a table, and not to difficulty in drawing the lines themselves. When children copy the component parts of line drawings of a table the pattern of error is very similar to that obtained when the whole line drawing is copied or when a table is drawn from imagination. When the same component parts are copied without the knowledge of what they represent very few errors are made.

Many theories of cognitive and social development in children refer to the child's drawing ability. This development is of such reliability that it is used as part of general tests of development (Goodenough, 1926; Harris, 1963). It is, however, not clear exactly what a normal child's developing ability to represent a three-dimensional object in two dimensions indicates in terms of cognitive development. Although young children usually pass through a conceptual phase of depicting people in tadpole form, few would argue that children really believe people to be of this form, or that children are convinced that the legs of a table really do splay out in all directions when they draw a table in this way. If a 'normal' child's visualization of a table is similar to that of an adult why do children not draw tables as adults do?

Most adults prefer to view a drawing that uses oblique projection (Hagen & Elliot 1976) rather than one drawn in linear perspective, and almost all adults prefer to draw a table in oblique projection. Examples of a table drawn in these projection systems can be seen in Fig. 1. Even very young children prefer to look at a table represented in oblique projection, even though they do not depict it in this manner. Further, when young children are given a completion task in which it is necessary to add only one line to the stimulus they will go to great trouble to alter the stimulus so that it accords with their normal form of depiction (Lee, 1988).

A substantial amount of work has already been done on the difficulties children experience in drawing and copying, and the possible causes of these difficulties. One is that difficulty is related to the physical task of drawing. Laszlo & Broderick (1985) examined perceptual-motor skills in copying diamond, square, and horseshoe shapes. They found that accuracy improved steadily with age, and partially with training.

The performance of five- and six-year-olds was poor, and children showed particular difficulty with the diamond and the horseshoe. Laszlo & Broderick argue that planning of action, error detection, and error correction may be sources of difficulty. The specific problems shown by young children are identified as inability to copy angles accurately, and failure of closure. These errors occur more on the diamond rather than the square (identical in shape, but rotated through 45 degrees) which indicates that it is not solely the physical shape of the object that causes problems.

Freeman (1980) suggested that development in table drawing could be related to inability to overcome figural biases. Bremner (1985) discussed the problem of figural biases in detail and suggested that there are three classes of bias: local bias, figural effects (such as symmetry), and extra-figural effects (such as the edge of paper). There are two biases that are particularly relevant here. The first is a local bias, called the perpendicular bias, in which the child shows a tendency towards drawing one line at right angles to another. This appears to be the most pervasive, and might account for the greater difficulty experienced by the young child when copying a diamond rather than a square. The second is a bias towards symmetry around an axis.

A further possible cause of difficulty is related to the child's conception of a table as a three-dimensional object and his or her inability or lack of experience in coalescing three dimensions onto a two-dimensional plane. Theoretically, when a child is asked to copy a line drawing the problems of translation from three dimensions to two dimensions are removed, as the subject is presented with the solution to copy. A further complication has been suggested by Phillips, Hobbs & Pratt (1978), however. A line drawing is seen as a solid object and the internal description created by this will describe the form of that object in three-dimensional space. Therefore, although the stimulus is two dimensional, the child may still experience the problem of translating three dimensions to two. Chen (1985) rejects this view. She found that children do not always produce the same drawings whether copying a line drawing or drawing a solid model. In particular, she points out that older children tend to produce more advanced drawings when copying a two-dimensional model than when copying a three-dimensional model. She defines more advanced as 'towards perspective representation'. Her criticism assumes that the only difference between copying from a two-dimensional or a three-dimensional model is that of the extra dimension and hence it ignores any extra figural effects that might occur, such as the relationship between the model, either a piece of paper or a solid object, and the table upon which it is placed, or indeed the whole room. This implicit assumption that children draw an object in a consistent manner is not necessarily well founded (Golomb, 1974). Nor is it the case that perspective is necessarily a more 'advanced' form of representation, as Lee (1988) showed that the form of projection used was partially a function of task demands. It is quite feasible that extra-figural effects might alter the task sufficiently to affect the form of projection used, independently of the dimensionality of the stimulus.

The four possible areas of error investigated here are:

(*a*) the problem of translating three dimensions to two;

(*b*) the problem of translating to two dimensions the three dimensions that are implicit in a two-dimensional figure;

(*c*) problems caused by figural biases;
(*d*) perceptual-motor problems.

The rationale behind the experimental design is as follows. The manner in which a table is drawn from observation, or from imagination was determined in detail by Lee & Bremner (1987) and Lee (1988). Although the use of a particular projection system was found to be task dependent subjects showed, with age, an increase in the use of 'affine' or 'projective' systems of natural perspective (as defined by Hagen, 1985), irrespective of the task. These data are used as a base against which a subject's performance can be compared when copying line drawings of a table.

In the first study reported here subjects were asked to copy line drawings of a table in various projections and the data were compared with those obtained previously. This comparison provides information on the difficulty of translating three dimensions to two, but suffers from the possibility of confounding extra-figural effects and three dimensionality implicit in the two-dimensional figure. It does, however, provide a baseline against which performance on copying 'meaningless' parts of the line drawing can be compared. In the next three studies reported here the subjects were asked to copy 'meaningless' parts of the line drawing, and the results were compared with those obtained on the first study. These comparisons enable figural biases to be isolated, as any similarities to the first study can be attributed directly to the form of the figure. The second study also investigates directly the effect that symmetry might have on figural reproduction. The fifth study enables the effect of implicit dimensionality to be evaluated by giving the 'meaningless' parts meaning, and hence implicit dimensionality, and then comparing the results with those in which the stimuli were meaningless (Studies 2, 3 and 4). Extra-figural effects are unimportant because the task of copying a collection of lines is the same in both cases. The only difference between the two tasks is the way in which subjects interpret the lines. A final comparison with Study 1, in which the lines have meaning and the results can be used as a baseline of copying performance, will enable the effect of 'meaning' to be investigated.

In order to ensure experimental naivety no subject was used for more than one study.

Study 1

Method

Subjects. The subjects were 795 children from one secondary school and one primary school in Leyland, Lancashire.

Task. The stimuli used can be seen in Fig. 1. Each child over the age of 10 was given a sheet with either stimulus 1, 3, 4, 8, or 9 upon it. The sheets were distributed in a balanced random manner and each child was asked to copy their particular stimulus accurately. Care was taken to ensure that the child could not see what his or her neighbours were doing.

The remaining 210 children were seen individually. Each child was first asked to draw a table from imagination. The stimuli used for the younger children were 1, 2, 3, 4, 5, 6, 7, and 8. The four extra stimuli used were included to examine the way in which table legs were copied. Each child was asked to copy first one and then another of the eight possible stimuli. The two particular stimuli each child was asked to copy were chosen randomly, balanced across age and sex. This task design enabled a check to be made on whether the younger children were actually responding to the stimuli or to some

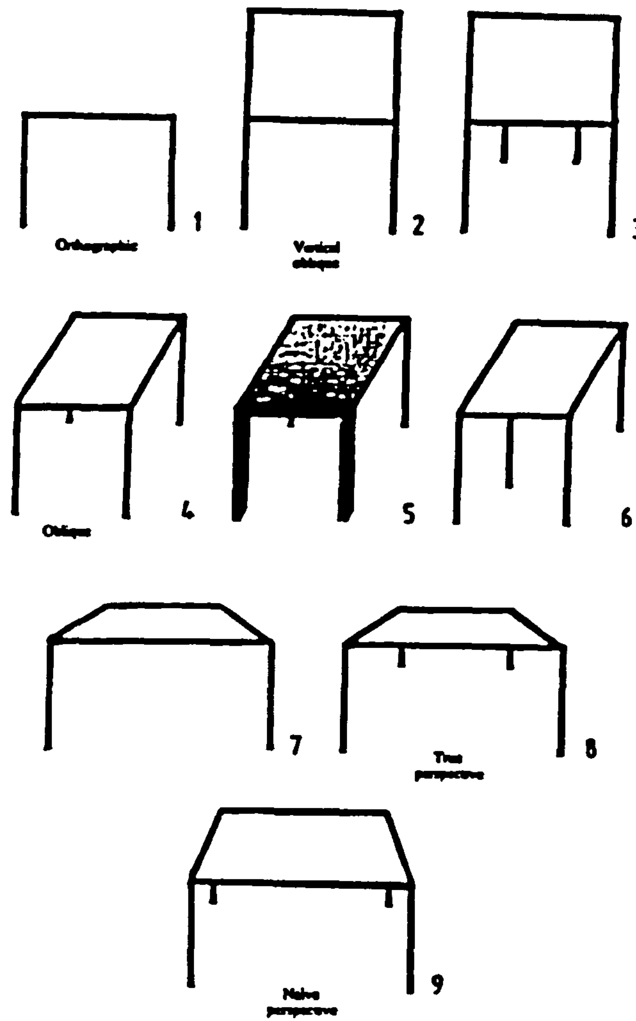

Figure 1. The nine different stimuli used in Study 1. See text for details.

preconceived graphic schema related to table drawing. Stimulus 5, identical to stimulus 4 except that implicit depth was enhanced by shading, was introduced to investigate whether such enhancement affected depiction.

Results

All drawings were analysed according to the system described in detail by Lee & Bremner (1987) and Lee (1988).

Preliminary analysis. (*a*) Each of the children between three and 11 years old copied two line drawings. Forty children produced the same response on both drawings; 13 children also used that response when drawing a table from imagination. These figures are too low to reveal anything of significance, and in particular to give credence to a theory involving a stage-like development in drawing, therefore they are not included in the rest of the analysis.

(*b*) Each child between four and 11 years of age copied two drawings, thus the responses are not all independent of each other. However, no significant differences were found when Kolmogorov–Smirnov comparisons were made on the proportions of correct responses, with age, between drawings copied first and second (orthographic: $n = 7$, $d = 5$, $P > 0.05$; vertical oblique: $n = 7$, $d = 2$, $P > 0.05$; oblique: $n = 7$, $d = 4$, $P > 0.05$; perspective: $n = 7$, $d = 2$, $P > 0.05$). Therefore the same qualitative pattern obtains if only the first drawing from each child is analysed. In order to minimize random fluctuation in the data due to a small pool of subjects both sets of data were amalgamated for the remaining analyses.

(*c*) A χ^2 comparison of the proportion of correct responses in each age group failed to show a significant difference between stimulus 4 and stimulus 5. For this reason responses to the two stimuli were amalgamated.

(*d*) The older children were given two different perspective tables to copy, one in true perspective (stimulus 8; 115 degrees convergence) and one in naïve perspective (stimulus 9; 36 degrees convergence). The mean degrees of convergence for each age group on each type of stimulus are given in Table 1.

It can be seen that a degree of accuracy was achieved when copying a table in naïve perspective, though not when copying a table in true perspective. The degree of convergence in the stimulus only appears to have a minor effect upon that shown in

Table 1. The mean degrees of convergence, with age, when copying a table in either true or naïve perspective. The standard deviation of the mean is given in parentheses beside each figure. The figure in square brackets represents the number of subjects who failed to give a perspective response (less than 20 degrees convergence)

Age...	11	12	13	14
Naïve perspective	40(11.5)	41(11.9)	37(9.9)	44(10.8)
Number of subjects	17	33[1]	37	25
True perspective	50(15.7)	52(18.1)	53(13.7)	61(18.2)
Number of subjects	16[1]	24[2]	34	29[1]

Table 2. The proportions of response, with age, for stimuli with a table top in orthographic, vertical–oblique, oblique, or perspective projection (measured as a percentage of the total response for that age)

Age...	4	5	6	7	8	9	10	11	12	13	14
No. responses	50	48	60	60	58	60	60	147	178	169	90
Orthographic stimuli											
Round	12										
Orthographic	66	60	86	100	88	100	88	100	100	100	100
Vertical–ob.	22	40	14		12		12				
Vertical–oblique stimuli											
Orthographic	26	12									
Vertical–ob.	74	55	100	80	100	100	88	100	100	100	100
Perspective		33		20			12				
Oblique stimuli											
Round	17										
Orthographic	14	19	13	2							
Vertical–ob.	48	75	63	74	54	20	15				
Oblique		4	22	17	46	80	85	100	100	100	100
Perspective	3			3							
Failure	18	2	2	4							
Perspective stimuli											
Round	20	6									
Orthographic		7	9	14							
Vertical–ob.	25	31	27	21	7	21					
Oblique									2		
Perspective	55	56	64	65	93	79	100	100	98	100	100

the response, yet only five subjects failed to use perspective. Because of the lack of difference in response between the two stimuli, responses to them are amalgamated for the remaining analyses.

Main analysis. (*a*) *Copying of the table tops.* Table 2 shows the responses analysed in relation to the type of table top given in the stimulus. This provided four classes of stimulus, orthographic (stimulus 1), vertical–oblique (stimuli 2 and 3), oblique (stimuli 4, 5, and 6), and perspective (stimuli 7, 8, and 9).

A three-sample χ^2 between the proportion of correct responses, with age, for orthographic and vertical–oblique and perspective stimuli failed to show a significant difference ($\chi^2 = 20.7$, d.f. $= 20$, $P > 0.3$). However, a four-sample test, including the responses on oblique stimuli, showed significant differences ($\chi^2 = 198.4$, d.f. $= 30$, $P < 0.001$).

Table 2 shows that where errors do occur they rarely take the form of an oblique response. The majority of errors on orthographic, oblique, and perspective stimuli are caused by vertical–oblique responses, and on vertical–oblique stimuli, by orthographic responses.

Oblique stimuli elicit a form of response that is qualitatively different from responses on the other stimuli. The similarity in the proportions of errors from the

Table 3. The proportions of correct responses, with age, for each stimulus and for each stimulus group. 'Oblique' depth [B] includes marginal errors, see text for details

Age ...	4	5	6	7	8	9	10
No. of responses ...	50	48	60	60	58	60	60
No implicit depth							
Stimulus 1	100	76	100	100	100	100	100
Stimulus 2	100	76	85	100	100	100	100
Stimulus 7	100	50	84	100	100	100	100
Average	100	67	90	99	100	100	100
'Oblique' depth [A]							
Stimulus 4/5	0	0	41	18	25	33	0
Stimulus 6	0	0	0	0	63	67	56
Average	0	4	20	9	44	50	28
'Oblique' depth [B]							
Stimulus 4/5	6	32	59	70	82	87	100
Stimulus 6	0	33	14	60	76	100	88
Average	3	33	37	65	79	94	95
'Perspective' depth							
Stimulus 3	0	34	43	60	63	84	89
Stimulus 9	20	38	40	25	63	57	80
Average	10	36	42	43	63	71	85

other three forms of stimuli indicate that these errors might be related to developmental factors linked to skill in copying. The oblique stimuli appear to present further problems that can only be related to either figural biases unique to those stimuli (such as in the drawing of two oblique parallel lines), or to some form of 'gestaltian' perception of the figure itself.

(*b*) *Copying of the table legs*. Analysis of the stimuli related to the way in which the table legs are depicted provides three stimulus groups: no implicit depth (stimuli 1, 2, and 7), implicit depth in a perspective manner (stimuli 3, and 9), and implicit depth in an oblique manner (stimuli 4, 5, and 6). In this analysis a response was considered correct if the table legs were depicted correctly, regardless of how the table top was drawn. Table 3 shows the proportions of correct responses with age for each stimulus.

A three-sample χ^2 test failed to show a significant difference between stimuli 1, 2, and 7 ($\chi^2 = 7.1$, d.f. $= 12$, $P > 0.8$). All age groups showed little difficulty in copying table legs that involved no depth. Similarly, a Kolmogorov–Smirnov two-sample test failed to show a significant difference between stimuli 3 and 9 ($D = 0.09$, $P > 0.05$). Both forms of stimulus elicit, with age, a steadily increasing ability to copy table legs in perspective. Responses for table legs in oblique depth show interesting

variations. There are significant differences between stimuli 6 and 4/5 as shown by a two-sample Kolmogorov–Smirnov test ($d = 0.5$, $P < 0.05$). However, 43 per cent of errors on stimuli 4/5 take the form of the table shown in stimulus 6, with the back leg that falls between the two front ones elongated, whereas 20 per cent of errors on stimulus 6 take the form of tables shown in stimuli 4 and 5 (true oblique). When this form of error is included in the analysis (i.e. when those drawings in which the subject is showing depth, but has not depicted the table legs with the same relative lengths as shown in the stimulus, are judged correct) a Kolmogorov–Smirnov two-sample test fails to show any significant differences between the stimuli ($d = 0.09$, $P > 0.05$), shown as 'oblique depth [B]'.

Even the youngest subject made very few errors when copying a stimulus with no implicit depth, however, these stimuli were less complex than those with either perspective or oblique depth, the copying of which produced clear developmental trends. A Kolmogorov–Smirnov two-sample test fails to show any significant differences between these last two groups of stimuli ($d = 0.07$, $P > 0.05$). The developmental trends shown on these two groups of stimuli appear to be similar. However, it is as yet unclear whether they can be attributed to the greater complexity of the stimuli, implicit depth in the stimuli, or a combination of the two.

Development in the copying of a table top in oblique projection or table legs in oblique projection or perspective is similar to development shown in drawing a table from imagination. All proportions of children correct at each age are significantly correlated with each other. (Table top and imagination: $r = 0.93$, d.f. $= 9$, $P < 0.001$; table top and table legs: $r = 0.93$, d.f. $= 5$, $P < 0.01$; table legs and imagination: $r = 0.84$, d.f. $= 5$, $P < 0.05$). Having a stimulus to copy elicits more correct responses than if the subject were drawing a table from imagination but the form of development is similar whether the table is drawn from imagination, copied from stimuli with oblique table tops, or copied from stimuli with legs in implicit depth.

Discussion

This study establishes baselines against which future copying behaviour can be evaluated. The first question raised by this study is whether the form of the oblique table top itself causes the difficulty children have in copying it accurately. This question is examined in the next study.

Study 2

The previous study showed that the majority of young children are able to copy a table top in perspective but not in oblique projection. This study is designed to discover whether the difference in rate of error, with age, between the two forms of stimuli is related to figural effects. The main figural differences between the stimuli are (*a*) symmetry around a vertical axis (in the perspective top) and (*b*) parallel oblique lines (in the oblique top).

Symmetry is an important aspect of a figure (Bremner, 1985). For example, five- to 9-year-olds judge symmetrical patterns as simpler than asymmetrical ones

(Chipman & Mendelson, 1975), and reproduce symmetrical dot patterns more accurately than asymmetrical patterns (Boswell, 1976). Failure to copy the oblique table top may thus be due to its lack of symmetry.

Similarly it is known that young children show difficulty when copying acute and obtuse angles (Bremner, 1985). Both forms of table top contain these angles, yet children are able to copy those in perspective stimuli. The main differences between the two forms of stimuli is that the orthogonals in the oblique form are also parallel. Mitchelmore (1985) states that 'young children can copy a line parallel to another line with considerable accuracy, but when the target line is inclined at an angle to the base line they generally show a systematic error towards the perpendicular direction'. The baseline in an oblique table top is not inclined at an angle, although the parallel lines of the oblique form might give this subjective effect. For example, it was shown by Lee (1988) that when subjects draw an oblique table from imagination younger children have a greater tendency to draw the oblique parallels converging.

This study was designed to find out firstly, whether the effect shown in Study 1 is still evident when only the table tops are drawn, and secondly, whether this effect could be attributed either to the symmetry of form and/or to the parallel lines.

Method

Subjects. The subjects were 171 children, aged between four and 11 years old, from a primary school on the outskirts of Preston, Lancashire.

Task. The subjects were seen as a class, in their classroom. The stimulus used can be seen in Fig. 2.

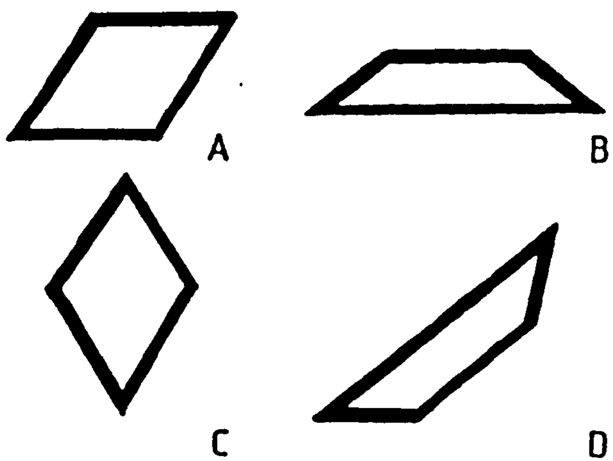

Figure 2. The stimulus used in Study 2. See text for details.

The stimulus was drawn in large scale upon the blackboard before the class entered. Each subject was given pencil and paper, and care was taken to ensure that the child could not see what his or her neighbours were doing. The stimulus was revealed and the teacher asked the subjects to copy the board as accurately as they could. When all the subjects had finished name and age were put on the back of the paper, either by the experimenter, the teacher, or the child.

Results

The stimulus can be analysed in four separate parts, marked A, B, C, and D in Fig. 2. Parts C and D are identical to A and B but are rotated to give symmetry around a vertical axis in C and oblique parallel lines in D, as can be seen in Fig. 2. None of these annotations were included in the original stimulus. Responses were measured in accordance with the classification of projection systems described in Lee & Bremner (1987). Further, the response to part C was only considered correct if it was symmetrical around the vertical axis, and the response to D was only considered correct if the two oblique lines were parallel. Parts A and B were the target shapes. As they were identical to the oblique and perspective table tops in Study 1 errors on C or D were not analysed if the subject copied both of them accurately.

Only 11 of the 171 subjects made errors on parts A and B. Three four-year-olds made errors on each part, and two seven-year-olds made no other errors. The remaining six subjects, mostly five-year-olds, made errors both on A and D, but none on B or C.

Discussion

The most striking aspect of the results presented here is the lack of error at all ages. Many studies have been done on the way children copy diamonds (see Mitchelmore, 1985) and the general consensus appears to be that young children have great difficulty with this configuration. The subject population used here did not appear to be unusual, being the intake of a normal state primary school, although there are three aspects of the experimental method that might be relevant. Firstly, because of the focus of the study errors on part C were only included in the analysis when subjects had failed to copy A or B correctly. In all age groups there were a few children who failed to copy C correctly, but because of this they did not fall within the scope of the analysis. Secondly, unlike most experiments the parts were presented as one unit. Several studies have shown that children alter their drawings in an attempt to differentiate between stimuli (see Light, 1985). It is possible that the presentation of all four parts together increased general accuracy as the children tried to clarify the differences between them. Finally, the copy was judged to be correct if its classification, as determined by measurement, was that of the appropriate projection system. Therefore these criteria are less stringent than those that measure minute deviations from the form of the stimulus, and may well add to the surprising lack of error found here. If this is the case it does not detract from the force of the argument presented here which is dependent upon a comparison between errors produced in this study and those from Study 1 rather than an absolute measurement of accuracy of copying.

The sparseness of errors means that the information obtained from the few errors that did occur should be treated with caution. No subjects had difficulty with only A and C, the oblique top, nor with B and D, the perspective top. Therefore errors obtained on those stimuli in Study 1 are not directly attributable to the shape of the table top. Similarly, no subjects had problems with A, C, and D, and so error is not attributable to oblique parallel lines. The errors that there were, mainly for five-year-olds, indicate that the only parts subjects found difficult were those lacking symmetry.

In conclusion, this study indicates that young children's inability to copy a table in oblique projection is not caused by figural bias related to the shape of the table top.

Study 3

Study 3 was designed to discover whether the inability shown by some young children to copy table legs in perspective is related to figural effects. Young children have a tendency, when depicting a table, to extend the back legs so that they are level with the front ones. This occurs whether the table is drawn from observation or from imagination, whether it is copied from a line drawing or is part of a completion task (Lee & Bremner, 1987; Lee, 1988). There is more than one possible reason for such a bias. If it is caused by a desire for order, or neatness of the figure, it should occur whatever the orientation of the figure. If it is caused by the desire to indicate the relationship between the figure and the ground the effect should only occur when the figure is correctly oriented. If it is not a figural effect, but related to the knowledge that the lines represent table legs in perspective, few errors should be made.

Method

Subjects. The subjects were 72 children, aged between four and nine years old, from a primary school on the outskirts of Leyland, Lancashire.

Task. The subjects were seen as a class, in their classroom. The stimulus used can be seen in Fig. 3. The procedure was the same as that used in Study 2.

Results

The stimulus can be analysed in four separate parts, marked A, B, C, and D in Fig. 3. Parts A and C are identical except for a rotation, as are stimuli B and D. Parts A and B are the target shapes. These annotations were not included in the original stimulus. A response was only considered correct if it was an accurate replica of the part. Six subjects either did not copy the figures in the correct orientation or did not copy the number of legs correctly. These responses were not included in further analysis, as they did not reveal anything about the child's strategy in relation to length of line. Only five subjects made any other errors. Two five-year-olds copied both B and D inaccurately, a child of five years and another of eight years failed to copy B, and a six-year-old failed to copy D.

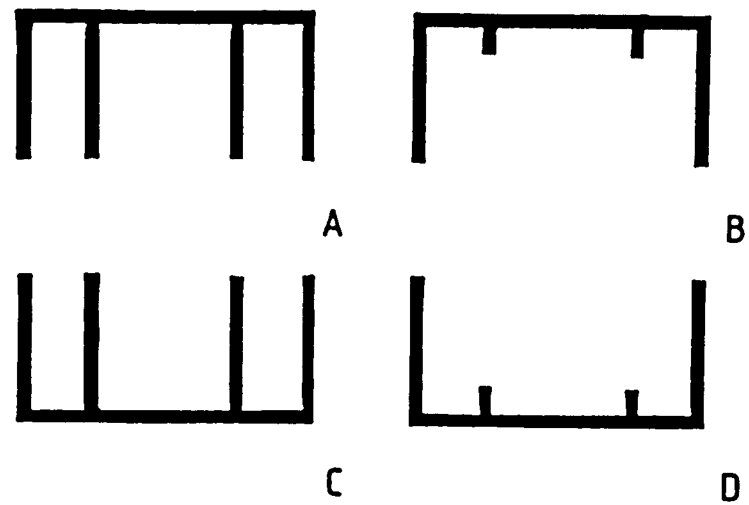

Figure 3. The stimulus used in Study 3. See text for details.

Discussion

As in Study 2 the most striking aspect of the results presented here is the lack of error at all ages. Once again the subject population used here did not appear to be unusual, being the intake of a normal state primary school. No subjects had difficulty with only A and C. Only two five-year-olds extended the shorter lines on both parts B and D, possibly showing a desire for figural coherence. One five-year-old and one eight-year-old extended the lines on B, possibly showing a desire for a ground line, and one six-year-old extended the lines on D. This supports the view that the other errors might be random.

Many studies have shown the importance of ground line to the young child. For instance Lowenfeld & Brittain (1957) used drawing to a ground line as a stage in the classification of children's drawings. The flat-bottom error in cube drawing is a good example of this phenomenon. In this the top surface of the cube is drawn correctly as a parallelogram, whilst the sides are extended to form a flat bottom. In an ingenious pilot study Willats (1981) asked subjects to draw a cube from a model. The model was either resting on a table below eye level, or resting on perspex above eye level. He found that in the second condition the 'flat bottom error' occurred at the top of the drawing. He concluded that the child is conveying the direction from which the object is viewed, not just the surface upon which the object rests. The suggestion that the error is caused by more than figural bias is supported by Freeman's (1986) discussion of the subject.

In conclusion this study indicates that young children's inability to copy a table in perspective is not caused by figural bias related to the shape of the table legs.

Study 4

Study 4 was designed to discover whether the errors made by the children in Study 1 were caused by figural effects associated with the form of table legs in oblique projection. Study 3 showed that when table legs are drawn in perspective the lengthening of the back legs is not related to figural bias. However, it is possible that table legs in the form of oblique projection are influenced by such a bias. Drawing table legs in oblique projection also involves the accurate depiction of an obtuse angle, and young children are known to have difficulty constructing such angles (Bremner, 1985). It is quite possible that this extra task demand causes the child to make ground line errors where they would not otherwise occur.

Method

Subjects. The subjects were 170 children, aged between four and 11 years old, from a primary school in Leyland, Lancashire.

Task. The subjects were seen as a class, in their classroom. The stimulus used can be seen in Fig. 4. The procedure was the same as that used in Study 2.

Results

The stimulus can be analysed in six separate parts, marked A, B, C, D, E, and F in Fig. 6. Part A is an obtuse angle. In B, C, and E lines are added progressively, such that E contains all the lines necessary for table legs in oblique projection and is therefore the target stimulus. Parts D and F are the alternatives to C and E respectively, in which the table legs extend to a ground line. These annotations were not included in the original stimulus. A response was only considered correct if it was an accurate replica of the part. If a child copied the target accurately, but made errors on other parts, these errors were not included in the analysis. Table 4 shows the errors, with age, for each part in the replication of the table legs.

Analysis was done in two parts. Firstly, errors on the copying of the oblique angle were analysed, and then the length of the table legs was examined. Table 4 shows that only seven subjects in total had problems with the angle. Two subjects used straight lines (s), three subjects used right angles (r), and two subjects used a combination of the two on different stimuli. Only one subject had problems with all the stimuli, she started using a right angle, but changed to a straight line on the last two stimuli. The other six subjects only produced errors as the stimuli became more complex. Twenty-seven subjects made at least one error in copying the length of the lines. The criteria were, however, very stringent, and almost all of these errors were only marginal. Marginal error occurred when subjects retained the relative lengths of the lines, but showed a tendency to extend the inside back leg slightly (j). Lee (1988) showed that this is a frequent error when a table is drawn from a model, from imagination, or in a completion task. The error that is being examined here, that of

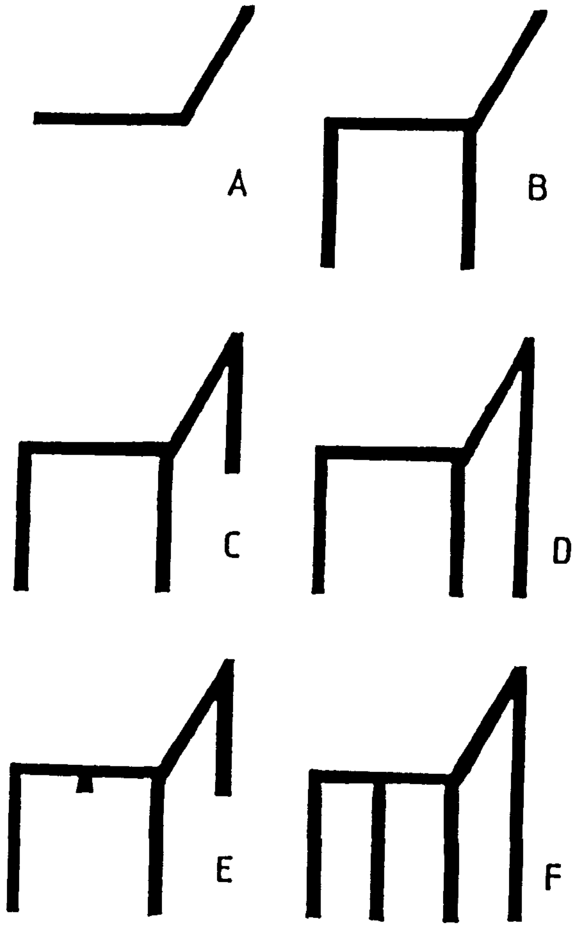

Figure 4. The stimulus used in Study 4. See text for details

Table 4. The number of errors in copying the table legs, by subject and with age, made on each part of the stimulus. The letter gives the form of error

Age ...	4			5						6				7			8			9					10					11
Subjects ..	1	2	3	1	2	3	4	5	6	1	2	3	4	1	2	3	1	2	3	1	2	3	4	5	1	2	3	4	5	
A		r	·	·	·	·	·	·	·	·	·	·	·	·	·				·			·	·	·	·	·	·	·	·	·
B	·	r	·	·		·	·	r	·	·	·	·		·	·			·			·	·	·	·	·	·	·	·		
C	·	r	·	·	·	·	·	r	·	·	rg	·		·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	g	·
D	·	r	·	·	r	·	·	r	·	·	j	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
E	sg	rg	g	r	r	j	g	rg	j	j	r	j	j	j	j	j	j	j	j	j	g	rg	j	j	j	g	j	j	g	·
F	s	s	·	·	r	·	·	r	·	·	s	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
No. of subjects	11			23						18				29			25			23					36					11

Key: g = all the legs were extended to a ground line.
j = the inside back leg was drawn slightly longer than the outside back leg
r = the oblique angle was given as a right angle.
s = the oblique angle was given as a straight line.
No other forms of error were made.

extension of all the lines to ground line (g), is made by eight subjects, but not in a consistent manner. For example, six-year-old subject 2 makes this error on an easy part but not on a more complex one. The errors are spread across the age range and do not indicate a consistent figural bias.

Discussion

As in the last two studies the most striking aspect of the results presented here is the lack of error at all ages. Once again the subject population used here did not appear to be unusual, being the intake of a normal state primary school, but again the study was unusual in that the parts were presented as one unit. More errors appear to be made as the parts become more complex, but there appears to be no consistent pattern in the type of errors made.

It is suggested that young children's inability to copy a table in oblique projection is not caused by figural bias related to the shape of the table legs.

Study 5

This study is designed to discover whether errors evident in Study 1 are caused not by figural effects associated with the form of the line drawings, but by the knowledge of what the lines represent. The target stimuli in each of the above studies are therefore presented again, together with an explanation of how they fit into a line drawing of a table.

Method

Subjects. The subjects were 109 children, aged between four and eight years old, from one infant school and one primary school in Leyland, Lancashire.

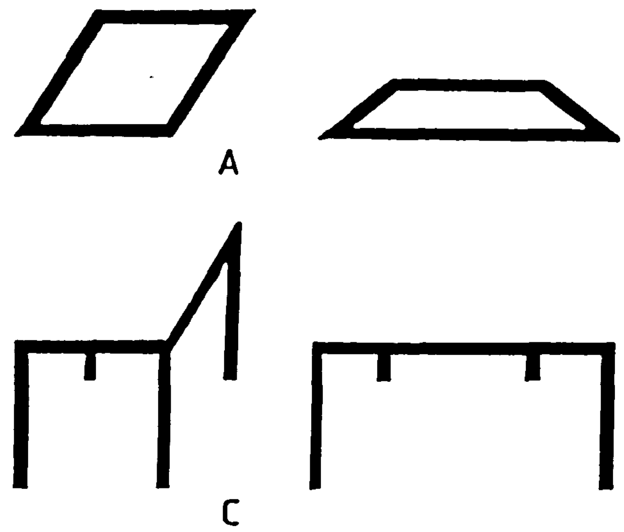

Figure 5. The stimulus used in Study 5. See text for details

Task. The subjects were seen as a class, in their classroom. The stimulus used can be seen in Fig. 5.

The stimulus was drawn in large scale upon the blackboard before the class entered. Each subject was given pencil and paper, and care was taken to ensure that the child could not see what his or her neighbours were doing. The stimulus was then revealed. Using the stimulus it was then explained how the perspective top fitted to the perspective legs, and the oblique top fitted to the oblique legs. The subjects were asked to imagine what they would look like if they were pushed together, and they were told that the drawings would both look like tables although they would be drawn in different ways. The teacher then explained that nobody was actually to draw a table, and asked the subjects to copy the lines on the blackboard as accurately as they could. When all the subjects had finished, name and age was put on the back of the paper, either by the experimenter, the teacher, or the child

Results

The stimulus can be analysed in four separate parts, marked A, B, C, and D in Fig. 6. These annotations were not included in the original stimulus. A response was only considered correct if it was an accurate replica of the part. Figure 6 shows the forms of response, with age, for each stimulus.

These results show that the youngest children had difficulty with each part of the stimulus. In conjunction with the results reported earlier in this paper they also show that children and adults when drawing table legs in oblique projection extend the inside back leg slightly (as in error type y illustrated above). Although this is not an absolutely correct response, it does accord with the spirit if not the letter of the law.

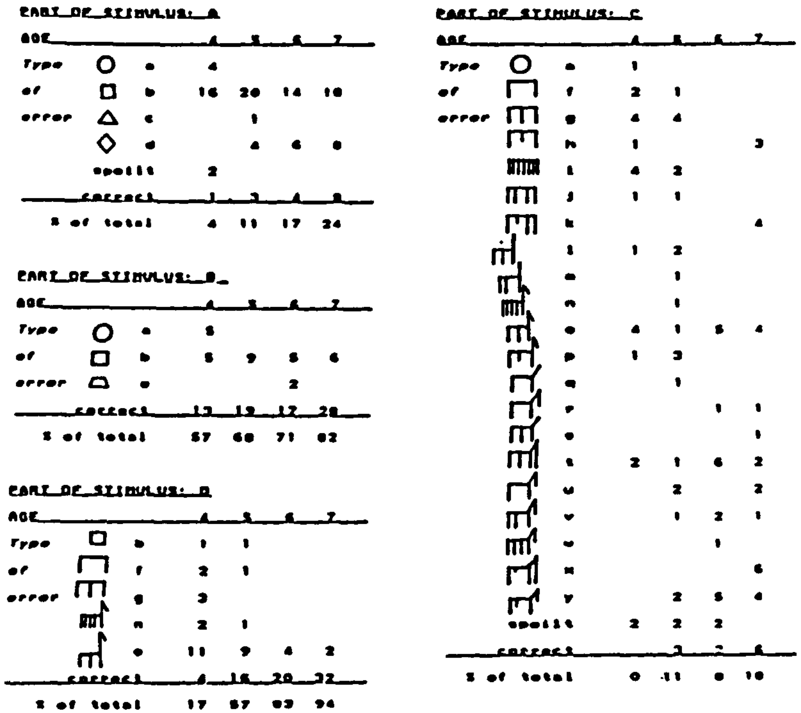

Figure 6. Types of error made in Study 5. This figure gives the number of individual subjects making each error and the total percentage of correct response, with age, for each part of the stimulus. The total number of subjects in each age group was 23, 28, 24 and 34 respectively.

Subjects of all ages appear to use this as an alternative method of depiction, showing no developmental trend, hence this response is classed as correct for the purposes of comparison.

When the proportions of errors for each age are compared by a two-sample one-tailed Kolmogorov–Smirnov test with those elicited by the target parts of the stimuli in Studies 2, 3, and 4 a significant difference between the two is found for parts A, C, and D, but not for B (the lines representing a table top in perspective) (Part A vs. part A, Study 2: $d = 0.16$, $\chi^2 = 6.1$, d.f. $= 2$, $P < 0.02$; part B vs. part B, Study 2: $d = 0.02$, $\chi^2 = 0.25$, d.f. $= 2$, $P > 0.7$; part C vs. part E, Study 4: $d = 0.21$, $\chi^2 = 11$, d.f. $= 2$, $P < 0.001$; part D vs. part B, Study 3: $d = 0.2$, $\chi^2 = 24.4$, d.f. $= 2$, $P < 0.001$). However, Kolmogorov–Smirnov two-sample one-tailed tests failed to

find any significant differences between the proportions of errors with age obtained in this study and those produced for either the table tops or the table legs on the appropriate stimuli in Study 1 (in which the complete line drawing is copied). (Part A vs. the copying of the top of the oblique table in Study 1, $d = 0.13$, $\chi^2 = 1.8$, d.f. $= 2$, $P > 0.2$; part B vs. the copying of the top of the perspective table in Study 1, $d = 0.02$, $\chi^2 = 0.21$, d.f. $= 2$, $P > 0.7$; part C vs. the copying of the legs of the oblique table in Study 1, $d = 0.09$, $\chi^2 = 1.6$, d.f. $= 2$, $P > 0.2$; part D vs. the copying of the legs of the perspective table in Study 1, $d = 0.04$, $\chi^2 = 0.54$, d.f. $= 2$, $P > 0.3$.)

Discussion

Subjects in either this study or in Studies 1 or 2 showed little difficulty when copying a table top in perspective. Each part of the stimulus presented in this study was identical to one presented in either Study 2, 3 or 4, yet there were significant differences between the way the subjects in this study copied parts A, C, and D, (table top and legs in oblique projection, and table legs in perspective) and when subjects copied identical parts in the three other studies.

Earlier it was argued that the ease with which the target parts of stimuli were copied could be related to the fact that they were presented with similar line drawings which might increase the saliency of minor differences between them. In this study all the target parts of stimuli were presented together. It is possible that the stimulus used here differed sufficiently to cause distraction rather than increased discrimination. If that is the case one might suppose that a comparison of responses obtained with the stimulus used here and the more complex stimuli used in Study 1 would show the same effect. However, even one-tailed tests failed to show any significant differences between the patterns of error obtained here and those obtained in Study 1.

An alternative, and more convincing, explanation is offered by another aspect of the results. In Study 1, when subjects were asked to copy line drawings of a table in different projections, subjects showed difficulty with the top and legs of the table in oblique projection, and with the legs of the table in perspective. These particular difficulties were replicated by the subjects in this study. The stimuli used here generally elicited slightly more correct responses than elicited by table tops or table legs in oblique perspective and by table legs in perspective, which may be attributable to the greater complexity of the stimuli in Study 1, but the patterns of errors in the two studies are remarkably similar. The only feature shared by the stimuli in Study 1 and the parts of the stimulus used in this study is the subject's knowledge of the object that is being represented.

To conclude, the pattern of errors obtained for each part of the stimulus was more closely related to that obtained on the relevant part of the different, and more complex, stimulus presented in Study 1 than it was to that obtained on part of a stimulus identical to one used in this study. The point of similarity between this study and Study 1 is that subjects knew in each case that what they were drawing represented a table. This knowledge dramatically altered the subjects' response on two otherwise identical tasks. Questions about why this effect is only apparent when table tops and legs in oblique projection and table legs in perspective are copied are examined in the general discussion that follows.

General discussion

It would appear that when subjects appreciate that the stimuli might be more than a collection of lines and could represent part of a table they unwittingly attempt to represent the three dimensionality that is now associated with these lines. Their performance on the task is then similar to the way subjects of their particular age are known to represent three dimensionality, in that younger children no longer copy the stimuli accurately and produce the same errors that they would if they were drawing a three-dimensional object. The same argument is used by Deregowski (1976). Deregowski & Strang (1986) used three-dimensional stimuli to show that that difficulty in representation might lie in the conflict between the desire to convey the overall appearance of the object and the attempt to depict its elements correctly. The degree of dimensionality of the stimulus is a different, though almost inseparable, variable to that of completeness of the stimulus. The studies reported here separate these two variables and suggest that the elementary parts are generally only depicted correctly if they do not have the 'meaning' of the whole. In conclusion, it is suggested that the knowledge that the lines represented a table, a three-dimensional object, caused the majority of errors obtained in Study 1.

If this is the case why do subjects only have problems with table tops and table legs in oblique projection, and table legs in perspective? What is it about these that imply depth that the other forms of stimuli used in Study 1 do not have? For example, a table top in perspective might also be expected to imply depth. However, its trapezoid shape, with the enlarged base, gives the appearance of sitting on a ground line rather than a ground plane. It looks like a balanced geometrical shape. Even with the knowledge that it represents a table top one can infer that it is a complete object on its own.

An oblique table top is unsymmetrical, and it has been shown that lack of symmetry does play a part in errors in copying this shape. However, it was also shown that this was not the whole reason. Mitchelmore (1985) suggests that an acute angle, in itself, might indicate depth, in that it is spontaneously interpreted as a representation of a perpendicular in three dimensions. The parallels in the oblique table top form one actual acute angle, and one implicit acute angle. Whilst the shape itself is copied with little error, the added knowledge that it could be a table top might trigger a spontaneous interpretation of depth.

It is easier to see how table legs in either oblique projection or perspective can have implicit depth. If the back lines are understood to be table legs both forms of stimulus imply hidden line elimination, in that the legs that come from the back must be partially hidden by the table top, and subjects 'know' that table legs must be of the same length and thus they are reproducing an invariant quality of tables. Two common methods employed by young children are the drawing of all the table legs to a ground line or showing them radiating from the table top (Lee, 1988). This is also the explanation given for the partial extension of the inside back leg in a table

drawn in oblique projection, a form of error that even adults are very prone to, and one that is evident in the studies described here.

It can be seen that implicit depth is apparent in each of the stimuli that children find problematical. The points raised here tie in closely with, and support, Mitchelmore's (1985) thesis which argues against a close relationship between isographic and homographic errors. Essentially isographic drawings do not have implicit depth, whilst homographic ones do. The difficulty, as Mitchelmore indicates, is in designing an experiment that isolates the productive aspects of isographic and homographic drawing. The studies reported here attempt to do that. Studies 2, 3, and 4 can be considered as isographic, whilst Study 5 can be seen as their homographic equivalent. The findings reported here strongly support the view that there is not a close relationship between the two. Freeman (1986) in summarizing experiments on cube drawing suggests that 'what the children learned was how to relate lines on the page to their mental descriptions of the particular object; they did not learn how to solve "the problem of depth".' Similarly Arnheim (1974) argues that the simplicity of children's schematic representation does not reflect graphic incapacity so much as it reflects the basic analytical categories through which the child organizes his or her world.

There are notable exceptions to the general development in drawing ability that has been described in this paper. Some autistic children show remarkable ability at a very early age, depicting complex scenes from imagination quickly and with photographic accuracy (Selfe, 1977, 1983, 1985). By contrast, even those normal children who are artistically gifted only show development a few years above their chronological age (Harris, 1963), and the drawings of other mentally retarded children are comensurate with their mental age (Stotijn-Egge, 1952). Further, the unusual drawing ability shown by these autistic children is not related to enhanced spatial ability, as this is usually found to be in keeping with their mental age (Hobson, 1984).

Some lower IQ adults also show remarkable drawing ability. O'Connor & Hermelin (1987) examined the relationships between intelligence and artistic ability on the one hand and skill at the recognition, matching, reproduction and copying of two-dimensional shapes with two levels of complexity and structure on the other. Their 16 subjects were adults with an IQ of approximately 50, eight of whom were idiot–savant artists and the other eight of whom formed a control group. Four subjects in each of these groups had been diagnosed as autistic or showed autistic features in their behaviour. The remaining 16 subjects were 11- to 13-year-old children of normal intelligence, eight of whom were artistically able. It was found that higher IQ groups were better at the recognition and matching of two-dimensional non-representational shapes, but idiot–savant artists were found to be as good as higher intelligence subjects and significantly better than IQ matched subjects when graphic production was required. This was also the case when graphic output was considered independently of any similarity of a drawing to a model. They concluded that 'the difference between the level of performance in visual as compared with visual–graphic tasks is determined by a specific IQ independent ability'.

What is this ability? The drawing ability of the idiot–savant artists was well above average, even though their reproduction and copying scores, and levels of motor coordination, were not found to be superior to those of normal controls. O'Connor & Hermelin suggest that the efficient accessing of graphic motor programmes depends more on artistic competence than intelligence and the ability to evoke visual images. They suggest that drawing might be partially independent of visual memory, and related more to encoded motor programmes primed by the sight of the model, and comment that

> the efficient use of domain-specific motor programmes by idiot-savant artists may indicate some sparing of cerebellar and/or motor cortex structures independently of whether they are autistic or not.

O'Connor & Hermelin also point out, their tasks are only tangentially related to artistic ability, as are the two-dimensional, non-relational stimuli they used, because the artist is more concerned with depicting a three-dimensional form in two dimensions. However, they do hypothesize that the idiot-savant might have 'acquired his high level of skill in drawing familiar scenes and objects because these allow him to draw on his long-term visual memory as well as on well-practised graphic descriptions'. Selfe (1983) found that autistic children with anomalous drawing ability normally executed their drawings from memory, but did not rely upon it entirely. She states that

> The autistic subjects ... appear to be attending to non-symbolic aspects of visual experience. Objects are truncated or partially occluded and represented without their defining characteristics, as seen from one fixed viewpoint. It is ... hypothesized that the autistic child, in drawing, records objects in his optic array more as patterns – edges, contours and shapes – rather than as representatives of classes or symbols (1985).

She also showed that such children do not appear to go through the same developmental sequence as normal children, in particular they appear not to show a 'conceptual' phase in their development. Paine (1981) made the same point when discussing children with exceptional artistic ability.

Baron-Cohen, Leslie & Frith (1985) found that autistic children fail in *conceptual* perspective-taking skill, as opposed to *perceptual* perspective-taking tasks, in which they succeed. They conclude that this constitutes a specific cognitive defect that is largely independent of general intellectual level and has the potential to explain both lack of pretend play and social impairment by virtue of a circumscribed cognitive failure. It must be emphasized that not all autistic children show exceptional drawing ability, but it is possible that this cognitive deficit plays a part in the drawing of those that do.

This paper shows that the ability of normal children to copy lines is affected adversely by the 'meaning' that these lines hold for the child. Unfortunately there is little reported about the relative ability to copy isographic and homographic drawings shown by subjects with anomalous drawing ability. Idiot-savant artists are relatively poor at visually matching or recognizing abstract shapes whilst they are relatively good at copying. Studies of drawing in autistic children have investigated free drawing, rather than the children's ability to copy lines, although Selfe (1977) reports that Nadia showed ability at copying lines accurately. The exceptional aspect of the drawings produced by both idiot-savant artists and by autistic children with

anomalous drawing ability is shown in the way they can depict a three-dimensional scene in two dimensions with photographic realism. Information on autistic children suggests that those with anomalous drawing ability are not limited by the symbolic importance of lines (Selfe, 1985). It is possible that all exceptional artists share this feature in some way. It is interesting to speculate that the cognitive deficit in autistic children suggested by Baron-Cohen *et al.* is related to the children's lack of attendance to the symbolic aspects of visual experience found by Selfe, and that the failure to copy meaningful lines in normal children is related to a lack of this deficit.

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References

Arnheim, R. (1974). *Art and Visual Perception.* Berkeley, CA: University of California Press.

Baron-Cohen, S., Leslie, A. M. & Frith, U. (1985). Does the autistic child have a 'theory of mind'? *Cognition*, 21, 37–46.

Boswell, S. L. (1976). Young children's processing of symmetrical and asymmetrical patterns. *Journal of Experimental Child Psychology*, 22, 309–318.

Bremner, J. G. (1985). Figural biases and young children's drawings. In N. Freeman & M. Cox (Eds), *Visual Order: The Nature and Development of Pictorial Representation.* Cambridge: Cambridge University Press.

Chen, M. J. (1985). Young children's representational drawings of solid objects: A comparison of drawing and copying. In N. Freeman & M. Cox (Eds), *Visual Order: The Nature and Development of Pictorial Representation.* Cambridge: Cambridge University Press.

Chipman, S. F. & Mendelson, M. J. (1975). The development of sensitivity to visual structure. *Journal of Experimental Child Psychology*, 20, 411–429.

Deregowski, J. B. (1976). Coding and drawing of simple geometric stimuli by Bukusu schoolchildren. *Journal of Cross-Cultural Psychology*, 7, 195–208.

Deregowski, J. B. & Strang, P. (1986). On the drawing of a cube and its derivatives. *British Journal of Developmental Psychology*, 4, 323–330.

Freeman, N. H. (1980). *Strategies of Representation in Young Children: Analysis of Spatial Skills and Drawing Processes.* London: Academic Press.

Freeman, N. H. (1986). How should a cube be drawn? *British Journal of Developmental Psychology*, 4, 317–322.

Goodenough, F. (1926). *Measurement of Intelligence in Drawings.* New York: World.

Golomb, C. (1974). *Young Children's Sculpture and Drawing.* Cambridge, MA: Harvard University Press.

Hagen, M. A. (1985). There is no development in art. In N. Freeman & M. Cox (Eds), *Visual Order: The Nature and Development of Pictorial Representation.* Cambridge: Cambridge University Press.

Hagen, M. A. & Elliot, H. B. (1976). An investigation of the relationship between viewing condition and preference for true and modified linear perspective with adults. *Journal of Experimental Psychology: Human Perception and Performance*, 2, 479–490.

Harris, D. B. (1963). *Children's Drawings as Measures of Intellectual Maturity.* New York: Harcourt, Brace & World.

Hobson, R. P. (1984). Early childhood autism and the question of egocentrism. *Journal of Autism and Developmental Disorders*, 14, 85–104.

Laszlo, J. I. & Broderick, P. A. (1985). The perceptual-motor skill of drawing. In N. Freeman & M. Cox (Eds), *Visual Order: The Nature and Development of Pictorial Representation.* Cambridge: Cambridge University Press.

Lee, M. (1988). The development of the portrayal of perspective, it's relationship to cognition and to cognitive mechanisms used in object drawing. Doctoral Thesis, to be submitted to The Open University, Milton Keynes, UK.

Lee, M. & Bremner, G. (1987). The representation of depth in children's drawings of a table. *Quarterly Journal of Experimental Psychology*, 39A, 479–496.

Light, P. (1985). The development of view-specific representation considered from a socio-cognitive standpoint. In N. Freeman & M. Cox (Eds), *Visual Order: The Nature and Development of Pictorial Representation*. Cambridge: Cambridge University Press.

Lowenfeld, V. & Brittain, W. L. (1957). *Creative and Mental Growth*. New York: Macmillan.

Mitchelmore, M. (1985). Geometrical foundations of children's drawing. In N. Freeman & M. Cox (Eds), *Visual Order: The Nature and Development of Pictorial Representation*. Cambridge: Cambridge University Press.

O'Connor, N. & Hermelin, B. (1987). Visual memory and motor programmes: Their use by idiot-savant artists and controls. *British Journal of Psychology*, 78, 307–323.

Paine, S. (Ed.) (1981). *Six Children Draw*. London: Academic Press.

Phillips, W. A., Hobbs, S. B. & Pratt, F. R. (1978). Intellectual realism in children's drawings of cubes. *Cognition*, 6, 15–23.

Selfe, L. (1977). *Nadia: A Case of Extraordinary Drawing Ability in an Autistic Child*. London: Academic Press.

Selfe, L. (1983). *Normal and Anomalous Representational Drawing Ability in Children*. London: Academic Press.

Selfe, L. (1985). Anomalous drawing development: Some clinical studies. In N. Freeman & M. Cox (Eds), *Visual Order: The Nature and Development of Pictorial Representation*. Cambridge: Cambridge University Press.

Stoutn-Egge, S. (1952). *Investigation of the Drawing Ability of Low Grade Subnormals*. Leiden: Luctor et Emergo.

Willats, J. (1981). Formal structures in drawing and painting. Doctoral Dissertation. Faculty of Arts, North-East London Polytechnic.

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